The FOUNDRY

Volume 50
Number 23

Published
Semimonthly

CLEVELAND, OHIO, DECEMBER 1, 1922

How Sanitary Ware Is Made--I

The Greatest Care Is Required at Every Stage in the Production of These Castings, Since the Slightest Surface Defect Will Prevent the Enamel from Adhering at That Point

BY PAT DWYER

EVOLUTION of the bath tub within even the past 50 years might be taken as a measure of the progress made by the population as a whole along hygienic lines during that period. Any person curiously inclined, who has the time and the inclination to consult history on the subject will find that bathing in some form or other always has been practised. The famous and elaborate, hot, cold and scented baths of imperial Rome were an outward manifestation of her power and glory and as such were carefully and consistently wrecked by the Goths and Vandals who contributed to the overthrow of the empire. Apparently these barbarians regarded bathing as something either useless or effeminate, or probably both and were determined that all those in the subdued territory should conform to the rigorous standards of the north which most assuredly did not include a dip in a scented bath either before or after the strenuous activities of the day. Viewed according to modern standards their judgment at the best is open to question, but apparently it met with high favor, not only at the time but for many centuries thereafter. Beyond a few medicinal springs where a limited number of people partook sparingly of the waters internally, water generally and as a means of wholesale ablution, seems to have been

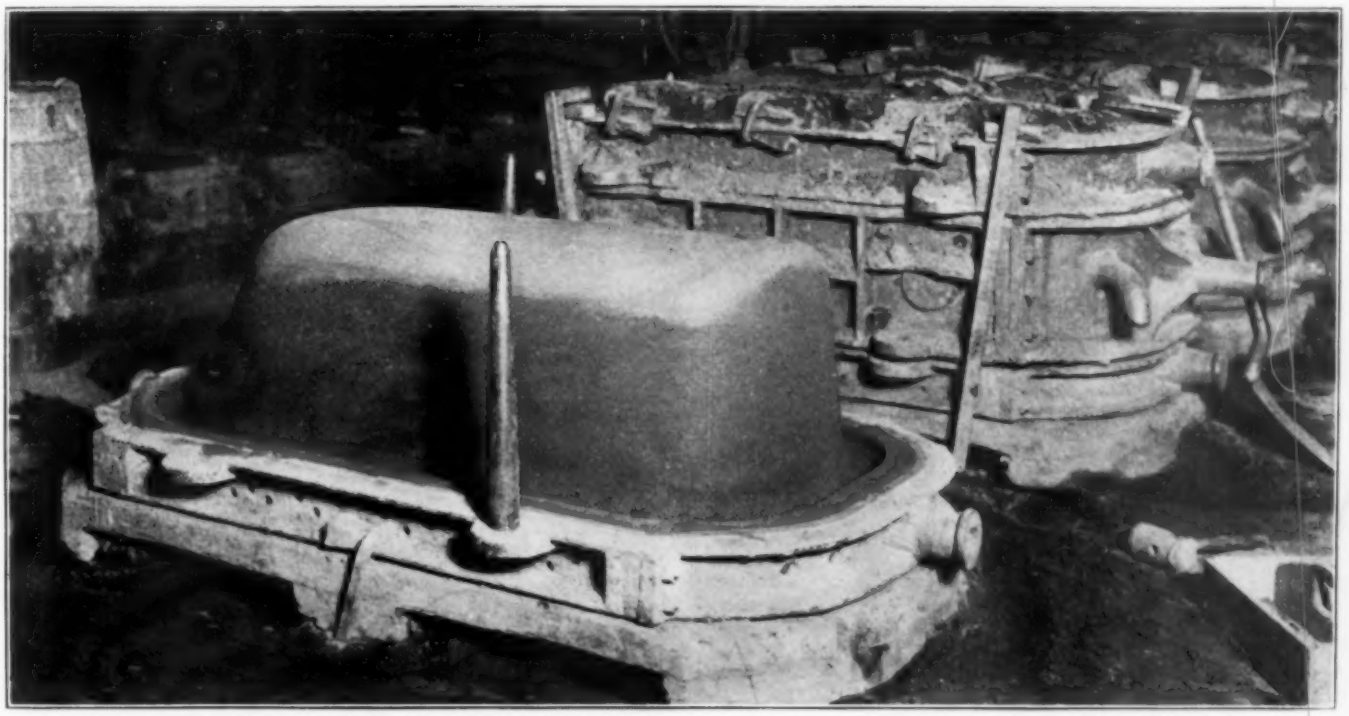


FIG. 1—MANY OF THE FLASKS ARE MADE IN SECTIONS FOR CONVENIENCE IN ASSEMBLING—WITH SUITABLE DISTANCE PIECES BETWEEN THE ENDS AND SIDES THE FLASKS MAY BE EXTENDED TO FIT VARIOUS SIZE PATTERNS

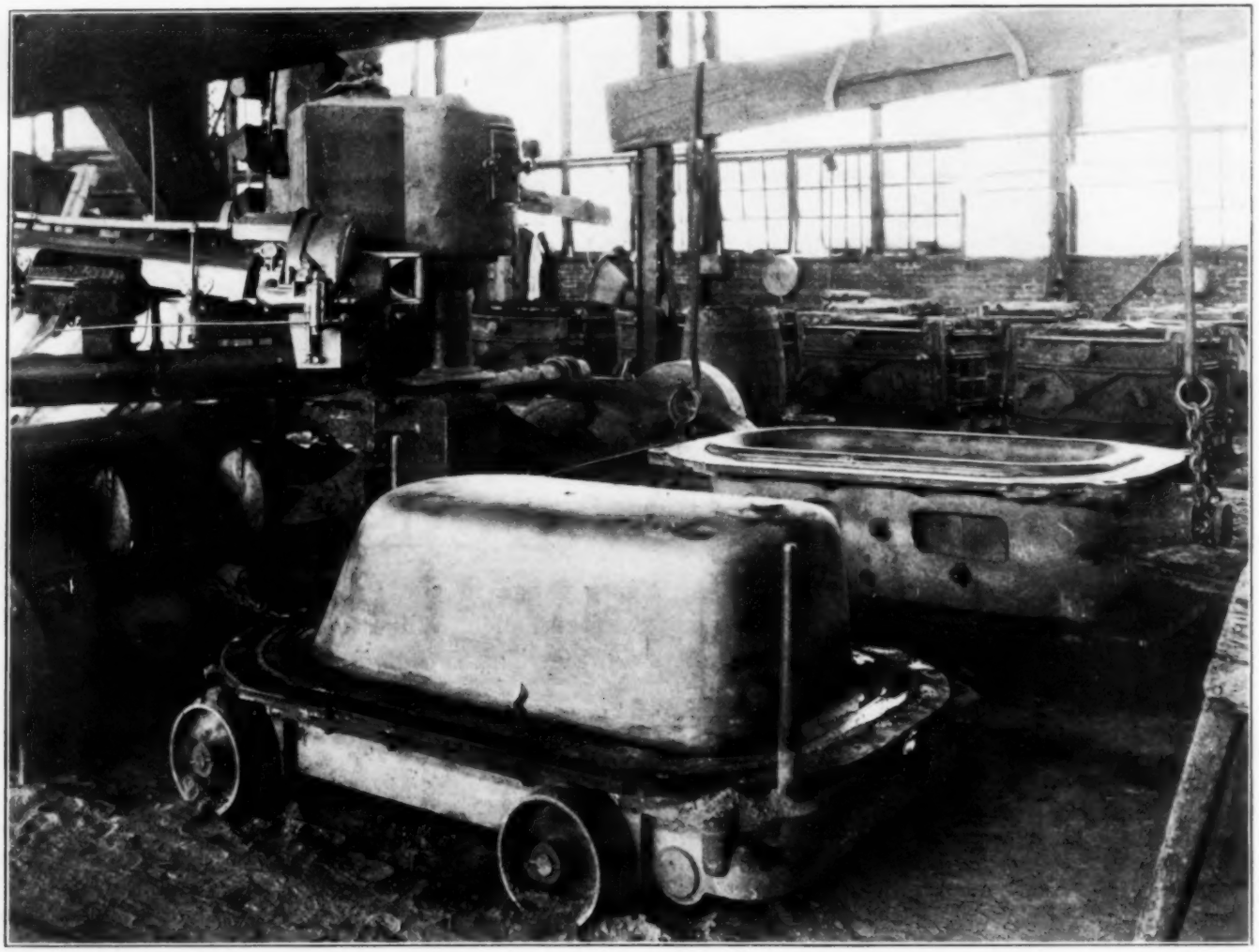


FIG. 2—A COPE AND DRAG PATTERN MOUNTED ON TRUCKS FORM PART OF THE EQUIPMENT USED IN CONNECTION WITH A SAND-SLINGING MACHINE FOR MAKING BATH TUBS

held in slight regard. History for the most part is discretly silent on the subject and beyond the fact that the upper classes used perfume freely we are practically free to draw our own inferences. One thing is certain, none of the houses was equipped with a bath room.

Men now living can remember the introduction of bath tubs in hotels and private dwellings in this country. Usually they were made of tin or zinc and incased in a wooden frame to insure stability. They were satisfactory to a certain extent, but they rusted easily and if any regular attempt was made to keep them scrubbed clean, they soon wore out. Porcelain tubs were made to some extent and so were tubs of copper, but the expense in both cases precluded the possibility of either one attaining popularity.

The first cast-iron bath tubs were modeled closely along the lines of the tin tubs already in use. They were designed to be enclosed in a wooden casing and therefore gracefull lines or a smooth finish was not considered essential. The metal thickness was about ¾-inch and the pattern, made of wood was rectangular at the corners. Usually the top and bottom lines were parallel and the entire casting had to be set up at a slight incline on the floor so that the water would drain out of it. This detail meant that two separate leg patterns were required, one a little longer than the other. One of the first refinements attempted on the cast iron tub was to attach a wood rim to the top. It was not altogether successful because it was made in several sections and afterward assembled and glued together. Alternately hot and cold, wet and dry, the wood warped, opened at the seams and pulled itself out of shape.

Gradually, refinements in design and methods of manufacture were introduced. Several large firms entered the sanitary ware business extensively, other firms took up the manufacture of certain items in addition to other lines in which they already were engaged, and a considerable number of companies have specialized in the manufacture of related equipment cataloged under the general heading, soil pipe and fittings. The manner in which this branch of the foundry business has expanded is summarized in a survey taken recently which indicates that approximately 500,000 bath tubs and a relatively equal number of bowls, lavatories, tanks, etc., are made yearly in the United States.

One of the prominent firms engaged in this business is the A. Weiskittel & Son Co., Baltimore. The present plant of this company covers an area of 11½ acres in that part of the city known as Highlandtown and is connected by several suitable spurs to the main lines of the Baltimore & Ohio and Pennsylvania railroad. An interyard system of tracks and a locomotive crane facilitate the movements of loaded and empty cars either in or out-bound. Enameled ware, stoves, etc., are shipped by the carload from a large warehouse or stockroom. Soil pipe and fittings are stacked in the yard and loaded directly into cars from there.

The business dating back to 1850, or, 11 years before the Civil war, is one of the oldest in the country, re-

maining constantly in the control of the same family. Founded by Anton Weiskittel Sr., in the shape of a small stove manufacturing enterprise, the scope of operations gradually expanded during the course of his active connection with the business and have been still further extended under the management of his two sons Anton Jr., and Harry. Among the claims set up by the company is one to the effect that it was one of the first in the field 40 years ago to engage in the manufacture of gas stoves and it still is making them. Innovations along this line included the introduction of nickel plating on gas stove parts and the origination of enameled tops and other hand parts on gas ranges.

In addition to stoves, the company at the present time is engaged in the manufacture of enameled sanitary ware and cast iron soil pipe and fittings. Two separate foundries are operated, one for the sanitary ware and stoves and the other devoted exclusively to soil pipe castings, both straight sections and special fittings. Other buildings comprising the plant group include a pattern shop, a power house, an enameling department, a machine shop, a brass foundry, mill rooms, carpenter shop, assembling, crating and shipping rooms, sheet metal shop and nickel-plating department.

Older readers of THE FOUNDRY will remember a remarkably comprehensive series of articles by Dillen Underhill on the manufacture of enameled sanitary ware published consecutively in THE FOUNDRY from March 1909 to June 1910. The present article does not propose to cover the subject exhaustively but merely to outline the practice in one particular plant. The general features of the process are fairly well standardized but every plant presents individual points of interest, depending upon size, location and output.

Making the Pattern

Owing to the peculiar and irregular shape and also to the extremely thin metal section of these castings, wood patterns are not applicable. This holds true, not only in the construction of the actual patterns, but also in the master pattern and the intermediate pattern. The patterns employed in the foundry are made of aluminum and iron and to secure these patterns it is necessary to first make a master pattern from some plastic material such as lead, wax or plaster. A mold is made from this pattern and poured with iron. Usually two castings are made so that one may be held as a spare. The iron pattern is filed and finished carefully and used to make a mold which is poured with aluminum. The aluminum pattern is cleaned and finished and placed in production in the foundry. The original master pattern is destroyed and the iron pattern is held in storage in the event that it might be necessary to make further aluminum patterns. Patterns wear out in time, accidents sometimes happen and occasionally it may be necessary to run duplicate patterns on several floors.

A lead master pattern for a sink with an apron plate and a double drain board is shown in course of construction in Fig. 5. It is built upon a wooden form from many pieces of sheet lead, bent to the required shape and sweated together at the joints. The wider sections are cut from rolled sheets, but the narrow strips were molded and cast. While the overall dimensions of these castings are not held to limits defined by thousandths of an inch, still the fact that two castings are made in turn from the original introduces a considerable contraction problem. Iron shrinks ⅛-inch to the foot and aluminum shrinks 11/64-inch to the foot from which it is apparent that the master pattern for a 5-foot tub or drain board would have to be made 5 feet 2¼ inches long to compensate for the shrinkage in the different steps down to the commercial casting. The iron

FIG. 3—THE IRON IS TAKEN FROM THE CUPOLA IN LADLES SUSPENDED FROM A MONORAIL WHICH EXTENDS TO ALL PARTS OF THE FOUNDRY FLOOR

FIG. 4—WASH BASINS ARE MADE IN CLOSE-FITTING FLASKS PROVIDED WITH HINGES ON THE FRONT SIDE

pattern would be 5/8-inch shorter than the master pattern, the aluminum pattern would be 55/64-inch shorter than the iron pattern and the castings made for shipment in the foundry would be 5/8-inch shorter than the aluminum pattern.

Lead lends itself readily to any shape, but on account of its weight it is difficult and awkward to handle and on account of its liability to distortion when unsupported it is not suitable for a permanent master pattern. For that reason it is only employed as a model from which a mold can be made for a permanent iron master pattern. Wax sometimes is used for the same purpose, and under certain conditions it is more suitable than lead. The main difference in their application is that while lead sheets may be built up about a skeleton form, the sheets of wax can only be assembled on a perfectly smooth surface conforming to the shape of the desired casting. For example, a bath tub pattern is made by constructing a wooden form corresponding in a general way to the cope of the mold. The wax, approximately 1/4-inch thick is spread over the form. Sometimes wax is employed to form the rolled rim, but usually wood pieces, either solid and provided with suitable core prints, or, carved to the desired shape are attached to the rollover board at the line where the rim joins the remainder of the pattern, sometimes while metal parts are employed. The drag then is rammed in the usual manner and rolled over and the sand on the interior holds the wax firmly in place while the cope is rammed. The mold is taken apart, carefully tooled and finished all over, then reassembled and cast. The iron pattern produced in this manner serves as a master pattern.

At the time the data and photographs for this article were secured the company was installing one of the sand-slinging molding machines made

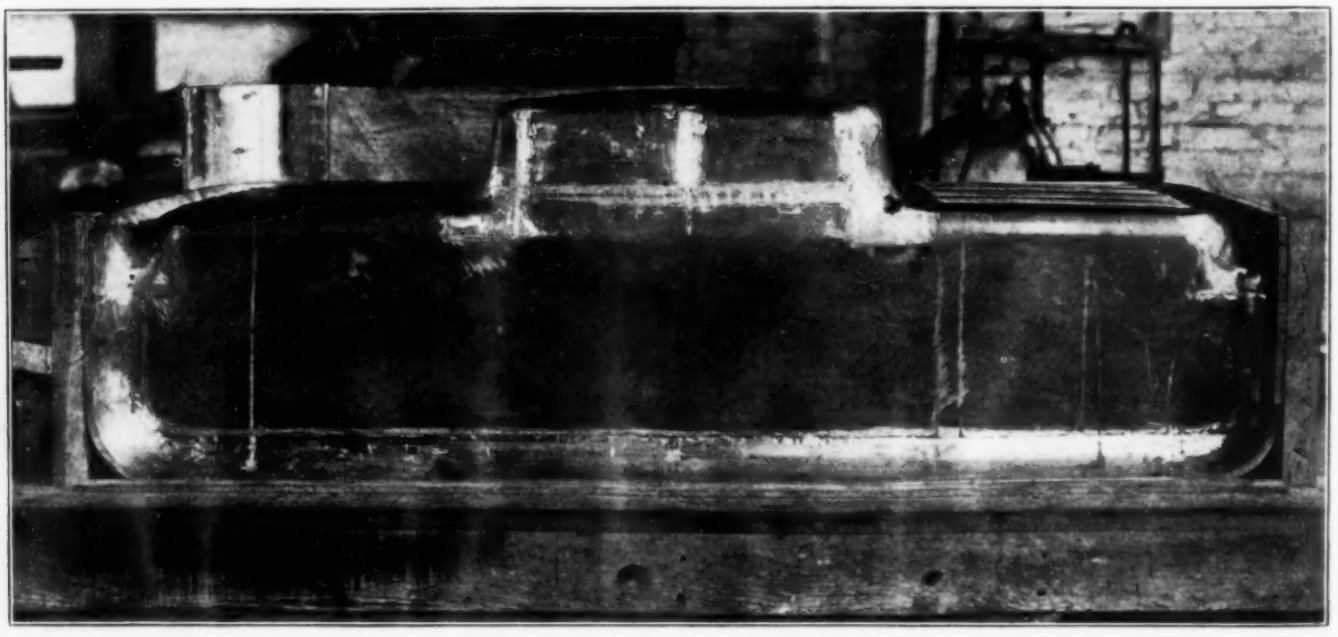


FIG. 5—THE MASTER PATTERN IS BUILT UP FROM LEAD SECTIONS, BENT TO SHAPE ON A WOODEN FORM AND AFTERWARD SWEATED TOGETHER AT THE VARIOUS JOINTS

by the Beardsley-Piper Co., Chicago, equipped for the manufacture of bath tubs in the manner illustrated in Fig 2. The machine is of the tractor type and has the patterns, one for the cope and one for the drag parts of a bath tub mold, mounted on trucks and attached to the machine in such a manner that as the machine advances the trucks and patterns follow. The machine and pattern equipment is installed in one of the long bays in the foundry served by a light electric traveling crane. The proposed method of operating is to provide a long sand pile, based on the amount required to fill a double row of flasks After the molds are poured the flasks are shaken out in the center of the floor and the flasks are piled in a row on each side, copes on one side and drags on the other. In this manner room is provided for a machine made by the American Foundry Equipment Co., New York, to cut the sand over during the night, and by piling the flasks approximately opposite where they will be needed as the machine travels along, no lost time will be experienced in placing the flasks on the pattern plate the following morning.

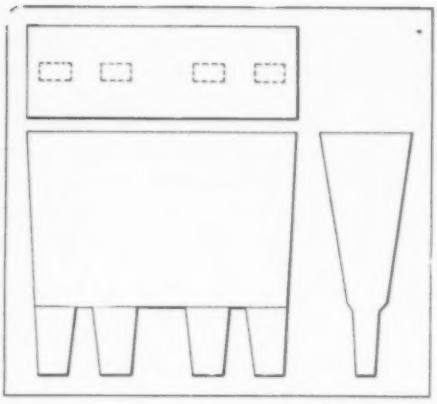


FIG. 6—TYPE OF RUNNER EMPLOYED ON BATH TUBS

The company regularly makes five different sizes of bath tubs and a considerable amount of preliminary work, fitting pattern plates, etc., is required before they all are adapted for use with the molding machine. The same truck will serve in all cases, but a separate pattern plate is required for each different size pattern. Another innovation being tried out with this equipment is the method employed in pouring the castings. A long runner connected to the pattern by a number of flat shallow branches is attached to the pattern plate along the joint line of the drag pattern. One of these long runners is provided on each side, served by a long upright runner extending the full heigh tof the cope. This runner is an experiment aad is designed to replace the present type of runner shown in Fig. 6, which is set at four points along a center line in the cope and directly on top of the casting. With the runner shown in Fig. 6 it is necessary to hold the entire ladle above the cope while pouring the casting, but with the other type, the ladle may be held alongside the flask as in ordinary foundry practice. In addition two ladles will serve instead of four.

Ample light and ventilation is assured in the side bay, the full length of the foundry, by a continuous window sash, extending from a low brick wall to the roof. This feature is shown in Fig. 7 which also shows one unit in the floor of bath tub molds made in this section of the foundry. This bay is approximately 25 feet wide and af-

FIG. 7—THE UPPER FLASK CONSTITUTES BOTH CHEEK AND COPE—INSTEAD OF BARS, A PLATE IS CLAMPED OVER THE TOP TO RESIST THE PRESSURE OF THE IRON

fords room for a double row of molds, besides a gangway in the center and a space at each side between the ends of the flasks and the wall on one side and the row of columns dividing the bay from the remainder of the shop on the other side. Only one row of molds is shown in the illustration.

Cast Iron Flasks

Although the entire floor in this bay is devoted to the production of bath tubs, the method of operation is elastic and readily may be adapted to meet changing conditions. The tubs are made on a piece-work basis, one molder and one helper constituting a crew. Each crew makes six tubs for a day's work and thus by increasing or decreasing the number of crews the tubs may be made in any multiple of six up to 250 and when the second bay, the one on which the molding machine is installed, is in operation, the number is doubled. A 1-ton air hoist suspended from a monorail over each floor is employed for handling flasks and patterns.

Up to the present, cast-iron flasks have been employed exclusively for making bath tub molds. They are strong and rigid and do not warp; characteristics essential to the production of this class of castings. Bath tubs are held within narrow limits in regard to weight and a uniform thickness of metal is a requisite in the enameling process. To thoroughly fuse the enamel the castings are raised to approximately 1800 degrees Fahr. and then slowly cooled and castings which vary in thickness to any appreciable extent invariably will crack during the process. To replace the cast-iron flasks a type of pressed-steel flask specially designed to give a uniform casting is under consideration in connection with the molding machine.

Two types of flasks are shown in Figs. 1 and 7. That shown in Fig. 7 is designed to be used on the smaller size tubs and consists of but two parts, a drag and cope. In addition, each part is a complete self-contained unit with bars, lugs, handles, etc., cast on. The second flask, shown in Fig. 1, is made up of three parts, a drag, cheek and cope. It may be noted also that the construction of this flask is different from that shown in Fig. 7. Each part is made in four sections, two ends and two sides, afterward bolted together. The second type of flask has two distinct advantages over the first. In the event of an accident a broken part may be replaced instead of scrapping the whole flask. By inserting distance pieces between the ends and sides as shown at *A* the flask may be extended to accommodate patterns of different lengths. An arbor, designed to support the comparatively large body of sand forming the interior part of the tub mold, is bolted to the drag in some of the flasks and in others, forms an intergral part of the drag casting. The joints on all flasks are machined to a true plane and the guide pins and holes are accurately machined, fitted and tested at frequent intervals and adjusted to compensate for wear due to friction and rust. On flat work a slight variation or looseness in the guides makes no appreciable difference, but on castings with parallel, vertical walls and with a thickness of only ¼-inch, the least laxity in this respect is fatal.

In making the mold the pattern is lowered into a suitable followboard which supports it while the drag is being rammed. The followboard also is provided with guides corresponding to those on the flask and thus the drag flask is located in its proper relative position so that an even thickness of sand is maintained between the pattern and the walls of the flask. Formerly all the flasks were provided with numerous vent holes, but with a fairly open grade of sand it was decided that these were not necessary and they have been omitted on flasks made recently. The manner in which the sand is rammed and the grade of sand employed are the two important factors in the production of bath-tub castings. The vent wire is not used to any extent. Where the proper grade of sand is rammed to the correct density and where the sand is not too wet, the amount of steam generated readily escapes through the top and bottom of the mold.

Even Thickness of Sand Maintained

New sand containing a little flour is riddled over the bottom face of the pattern. This precaution is observed to prevent the face from cutting while the mold is filling with iron. All the iron is poured through four runners directly on top and the incoming metal falls directly on the exposed sand all that time. The remainder of the pattern and the frame constituting the drag flask are filled with heap sand *tramped-off* in courses. The butt rammer is employed at two points, once above the sand that will form the joint of the mold after the drag is rolled over and again, just before the surplus sand is scraped off to make a place for the bottom board.

Just before the bottom board is bedded on the drag a channel is scraped in the sand and the vent wire employed to form a row of vent holes around the inner wall of the pattern. After the drag and follow board are rolled over and set down upon a relatively level bed, the follow board is removed and set down in readiness for the next mold. After the sixth drag is rammed the board is put away until the following day.

Poured on Top

The cheek flask is provided with a number of short *chucks* spaced a considerable distance apart and with the ends far enough back from the pattern to allow the molder to ram continuously around the pattern instead of lifting his rammer in to and out of a number of pockets. The chucks only extend about half way up the sides of the cheek and therefore do not interfere in any manner with the ramming above that point. Where a cope is employed, it merely takes the place of an *upset* or, extension to the cheek. No parting is made between the cheek and cope and both cheek and cope are lifted from the pattern as a unit. The cope is not barred, but after it is rammed full of sand, a flat plate, provided with openings for the runners, is bedded down and clamped to the top flange as may be noted in the illustrations Figs. 1 and 7.

A drag rolled over, ready to receive the empty cope is shown in Fig. 7. The dove tails to which the legs afterward are attached are made by placing suitable tin forms over straight lugs provided on the pattern for that purpose. This has been found to be a better and more convenient method than either forming them in cores, or, forming the dove tails loose and drawing them out of the cope after it had been lifted off .

Two types of flasks for making wash basins are shown in Fig. 4; one made of iron the other of wood. The pattern is molded in the same position in both flasks and in the hands of skilled operators the output is the same. However, it is apparent that the increased life of the iron flasks will more than make up for the difference in first cost. The iron flask is rigid, retains its accuracy indefinitely and the success of the molds made in it do not depend on the skill of the molder to such an extent as those made in wood flasks. In the wood flask shown to the right of the illustration it may be noted that the mold is made in three parts, a cope, a drawback and a drag. The drawback is hinged to one side and is lowered back out of the way after the cope has been lifted off. After the pattern has been drawn from the drag, the drawback is returned to its place and clamped, and

then the cope is set on. In the iron flask the drawback and cope are in one piece and as such are lifted together, being supported by two aluminum hinges at the front of the flask. A follow board is provided on which to ram the drag, and on account of the special shape of the flask the amount of sand required to fill it is reduced to a minimum.

Iron for the castings is melted in a cupola, lined to 60 inches, made by the Whiting Corp., Harvey, Ill. It is located practically on the center of the floor and the charging platform supported on suitable columns and I-beams extends well into the shop. A second cupola erected close by and served by the same charging platform is held as a spare to be used in the event the other cupola goes out of commission temporarily for any reason. The feature that stands out most prominently is the necessity of producing an absolutely clean skin on the casting. To that end the gates and runners are kept scrupulously clean. The enamel will only unite with clean iron. Therefore, spots or pin holes on the surface, due to particles of sand, or even to free carbon thrown off on cooling by the metal, will prevent the enamel from adhering.

Castings Are Sandblasted

Due to the thickness of section and the general character of the castings, chipping and grinding is not severe. The castings are sandblasted in four rooms equipped with pressure tanks and a hose arrangement designed by H. C. Weiskittel, general manager of the company. By an ingenious arrangement including a small cylinder and a hinged lever, the door of the sandblast room automatically is closed when the operator commences to clean the castings and in a similar manner the door opens the instant he shuts off the air from his hose. Air for the sandblast is furnished by a direct steam driven Ingersoll-Rand compressor located in the power house. A steam engine in the power house furnishes the motive power for a generator set, pumps and a positive pressure blower made by the P. H. & F. M. Roots Co., Connersville, Ind., which supplies air to the cupola about 100 feet distant. The enameling room and the soil pipe foundry will be considered in the next following issue of THE FOUNDRY December 15.

Method of Joining Metal Pattern Halves

BY C. G. SPICER

ALTERATION in design made it necessary to shorten by several inches the base column pattern shown in the accompanying illustration. The aluminum pattern, made in two halves and doweled and screwed to a pattern plate, was removed from the plate and reassembled as a unit. The dowel holes served to locate the two halves in their proper relative position to each other and then the complete pattern was placed in a lathe where two grooves ¼-inch deep were cut as indicated in Fig. 3. The outside edges of these grooves corresponded with the limits of the section to be removed. The lathe was run slowly and the sharp parting tool was provided with clearance at one side to prevent it from digging in. The metal thickness of the pattern wall was about ⅜-inch which left about ⅛-inch to be cut through with a saw after the pattern had been removed from the lathe and placed on the bench. The turned grooves served as a guide in joining the ends accurately for the shorter pattern. A new layout was made on the plate and then the several halves were rearranged preparatory to joining them together. Three ¾-inch holes were drilled through each section about 1 inch from the dividing line as shown in Fig. 4. A quantity of clay, kept back about 1 ½-inches from the junction line as indicated in Fig. 5 was packed into each section of the pattern and then the two parts were placed in their proper position on the pattern plate where the space between the clay walls was filled with babbitt. The lower ¾-inch holes were covered with clay to prevent the babbitt poured in through the upper hole, from leaking out. The second half of the pattern was treated in a similar manner.

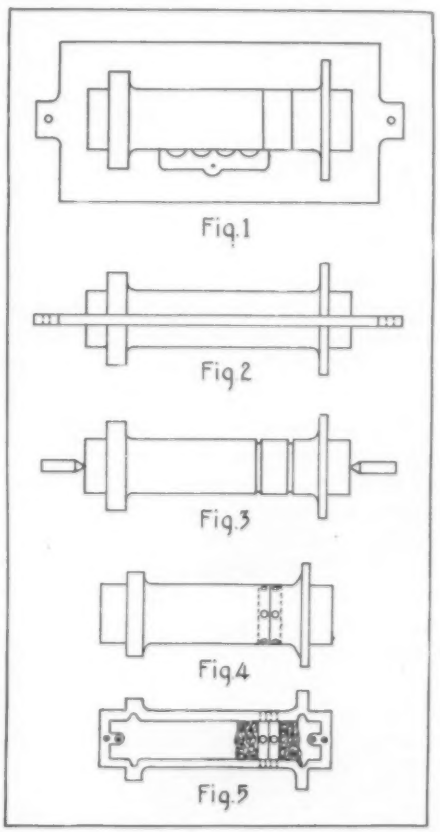


FIG. 1—ORIGINAL PATTERN FIG. 2—AS IT APPEARED ON THE PLATE FIG. 3—IN THE LATHE WITH GROOVES CUT FIG. 4—THREE ¾-INCH HOLES DRILLED THROUGH EACH SECTION TO ANCHOR THE BABBITT FIG. 5—JOINT SIDE OF REPAIRED PATTERN WITH CLAY AND BABBITT BOND IN PLACE

After they had cooled they were fitted and tested and then attached in their former position on both sides of the plate where the babbitt bond held the parts firmly together.

Experiments in Pig Iron

The Hartford Electric Light Co., Hartford, Conn., has made arrangements to operate the plant of the Connecticut Electric Steel Co., in that city for a test run to make synthetic pig iron. This process is designed to convert steel scrap into gray iron by increasing the carbon content and at the same time refining the iron by the elimination of impurities. The object is to determine the commercial possibilities of the process under local conditions. It is the claim that it will be possible to produce pig iron of analysis superior to the blast furnace product at a price to compete with the delivered cost of blast furnace pig iron in New England.

The Pennsylvania Foundry Supply Co., Liberty building, Philadelphia, producers of all styles of foundry chaplets as well as other foundry supplies and equipment and facings have appointed Mr. S. B. Wentz general manager. Mr. Wentz was formerly connected with the Lindsay Chaplet & Mfg. Co.

The states of Connecticut, New York, Michigan, Pennsylvania, Ohio, Illinois, Wisconsin, Massachusetts and New Jersey produce 91.1 per cent of the brass, bronze and copper products manufactured. This fact was developed through the 1919 census of the department of commerce.

Makes Tax Report Cost Basis

Cost System Conforming to Forms Supplied by Government for Reporting Incomes Does Not Require Much Extra Work but Enables the Foundryman To Price His Castings Correctly—Too Lax at Present

BY THOMAS HARPER

WE CLASSIFY and assemble our manufacturing costs so that they can be used in our report made to the United States government for income tax purposes. The classifications shown in the accompanying tables are only those applicable to making brass, bronze, and aluminum castings. The system uses the fewest classifications that we have found practicable. The same system is being used with appropriate classifications by electroplaters and polishers, manufacturers and automobile sundries, brass finishers, electric motor repair establishments, machinists, patternmakers, manufacturers of vacuum cleaners, lumber dealers, hardware dealers and tile layers. All of these different trades have found it efficient. As they must have such data accumulated for the tax report it costs them practically nothing to get their costs, and removes the worry attendant on making out special tax reports or answering any governmental detailed inquiries as to how they arrive at their deductions. Even if tax reports were not required it would be necessary to do the bookkeeping thoroughly and this method costs no more than the simplest methods and gives an accurate cost basis. But no matter what it costs, every business has to be able to bear the costs of finding the cost of doing business; it is the most necessary expense. This system can be used, as the tax report can, to completely cover the smallest or the largest business in the country. It is only a matter of classification.

Of all the handicaps that retard business success none is more serious than the ignorance of manufacturers in the matter of production costs. The federal trade commission reports that in the United States only 10 per cent of our industrial establishments know what it actually costs them to manufacture their products; 40 per cent simply estimate their costs, and 50 per cent have no method whatever of finding what their production charges really are. This condition is largely responsible for a national situation where more than one-third of our 300,000 manufacturing concerns did not earn 1 per cent on the billions of capital invested in them.

The New York board of chartered accountants claimed that less than 4 per cent of the concerns in New York state were doing a business of less than $100,000 per year that knew the costs of manufacturing their product.

Of the wills offered for probate in the city of New York less than 10 per cent of the estates were solvent. This proves that only about 5 per cent of the concerns in business make a profit on their work or business and they must surely be the men that know the cost of production and make right prices.

That the problem of finding costs in any business is a pressing one is shown by the large number of articles in magazines and trade papers in regard to business costs in general. That the man or company who does not keep costs, and make his prices strictly in line with those costs, is not doing business honestly or sanely is evident. Open competition is what is demanded, and is a necessity for advancement, but competition in price should be strictly the result of costs.

Costs vary under different conditions. Lower costs may be due to better equipment than competitors. They may be due to better location in relation to the market or to lower wages per unit produced paid by one employer than another in the same line of work. Whatever the reason the price should be made according to those costs of your own establishment only, and it is your duty to know them, and know how to apply them to price making.

That our business suffers, just as much as any other, is shown when we hear that a large foundryman in the Pittsburgh district said that it would pay him to install free of charge a cost keeping system into every foundry that competes with him and put in a man to keep it working. He claimed that if his competitors knew their costs and made prices from these costs, it not only would benefit him but there would be fewer of his competitors become bankrupt.

During the war complaint was made that the malleable iron foundries were charging too high prices to the government. They were investigated. A corps of accountants was put on the case and it was found that 75 per cent of the customers were not paying high enough prices and only 25 per cent of the customers were paying prices that paid for the expense of making the castings and the services rendered. This condition was found to be due to the foundries' cost accounting, or lack of it. The foundries were advised to increase their prices.

No prices should be made at a guess or to meet the other fellow's prices, or at the price that the buyer suggests.

Prices that are equitable should be set from costs found in the foundry, and from these costs alone. These prices should be such that they cover the cost of material and labor and leave a reasonable amount for interest on the amount invested in the business. This can be done only if castings are sold no lower than it costs to produce them plus a fair margin of profit.

Nearly all the trouble seems to be caused by mixing up profits and overhead. The direct labor and material will be figured all right, but the indirect labor and material, the fixed charges, depreciation and interest on capital all seem to be forgotten. If you ask most business men about them they will tell you that the overhead comes out of the profits, but it does not. The last thing that is left is the profit, and there is exceedingly little of it when all the other costs are paid. That appears to be proved by the statement that 95 per cent of all the concerns that are in business go through bankruptcy inside of 25 years.

If you invested in any manufacturing or commercial business you would at least expect a return of 8 per cent, and if you did not have an expectation of getting more you would never put your money into it, on account

Paper presented at the October meeting of the Metropolitan Brass Founders association, held in New York.

Table I

Melting Coremaking and Alloy Costs

MELTING COSTS

Govt. Form 1040
Schedule B

Item 2	Melters' wages
5	Employers' liability
3	Materials and supplies—fuel, crucibles and furnace
	Direct total
	Percentage of overhead
	Direct and overhead combined total
	Burden 20% of direct and overhead total
	Gross total

For hour price, divide the gross total by melters' hours. For pound price divide the gross total by pounds of castings *sold* which gives the average melting cost per pound.

COREMAKING COSTS

Item 2	Core makers' wages
5	Employers' liability
3	Materials and supplies
	Direct total
	Percentage of overhead
	Direct and overhead combined total
	Burden 20% of direct and overhead total
	Gross total.

The coremakers' hour price is found by dividing the gross total by the hours worked.

ALLOY COSTS

Item 4	Combined price of metals constituting alloy
1 and 4	Loss on metals
	Alloy cost direct total
20	Burden 20% of direct total
	Gross cost of alloy

EXAMPLE

Copper	88 lbs. @ 14c	$12.32
Tin	10 lbs. @ 32c	3.20
Zinc	2 lbs. @ 7c	.14
		$15.66

Loss on metals 10%	$ 1.56
Cost of alloy	17.22
Burden 20%	3.44
Gross cost of alloy	$20.66

of the risk of loss. The census figures show that capital is a constantly increasing factor in production. In 1899 the capital invested in manufacturing in the United States amounted to $1770 for each person employed in the industry; in 1904 it was $2117 for each person employed; in 1909 it was $2488, and in 1914 it was $2848. What do you need?—See under *Capital*, Table III.

Interest on the capital invested is a charge and has to be paid for and should be charged directly to manufacturing and not to profit and loss account as is usual, or deducted from the profits if any, or considered as a profit. It should not be considered as a profit, no more than a workman considers his wages a profit. Interest should be included and charged on the pound of castings just as if it were wages.

What the United States government allowed during the war is a fair amount; that is, 10 per cent net profit. It ought not to be less. By 10 per cent net is not meant 10 per cent over the net cost of labor and material used, but 10 per cent over all the costs and overhead as well. That is what the government allowed, and, is the amount we have been using as a basis to make prices by.

In every branch of industry men can be found who know the manufacturing costs of their products and we have never found one of those men a price cutter. The 90 per cent mentioned by the federal trade commission as not knowing their costs, cut so much that there is nothing left as a margin to be cut by the firms that know the cost of production.

It is often argued that the only solution to the problem of price cutting is a combination through a central bureau to control prices, but such a combination must stay within the law. The only combination that is allowed to operate, according to law, through a central bureau is the labor unions and their right to sell labor by collective bargaining is denied to those who would like to combine to sell the products of that labor.

A combination through a central bureau to control prices is not needed, but what is needed is a standard system of cost-finding. We pay the same price for metal, materials, supplies, labor, machinery, etc. If proper cost accounting, or a standard method of computing costs such as the United States government has established, is used, different foundries ought to come close to the same cost of production.

When price is computed according to the costs they should not be deviated from, or a lower basis taken than the one which has been figured as fair. All kinds of bluffs will be made to get lower prices. All buyers consider foundrymen are easy to buy from and that they can always get a lower price than that first quoted; they know that foundrymen do not

Table II

Overheads, Burden and Productive Labor

PRODUCTIVE LABOR OVERHEADS

Govt. Form 1040
Schedule B

Item 2	Wages paid for bookkeepers
2	Wages paid for shipping and receiving
2	Wages paid for plant upkeep
5	Employers' liability for above wages
3	All materials and supplies used by above
10	Salaries, bonuses and commissions not charged as labor
11	Rent on business property
12	Interest on business indebtedness to others
13	Taxes, city, state and federal
14	Depreciation of machinery, tools and fixtures
16	Bad debts owing from sales if not fully covered by burden
17	Other expenses, fire insurance, 'phone, credit, information, lawyer's fees, collection charges, light, heat, power, etc., and all other expenses not already charged and necessary to the conduct of the business
	Total

BURDEN

	Interest on capital employed @ 12½%—on gross business	5%
	Profit	10%
Item 20	To provide for discounts, lost accounts and allowances	5%
	Total	20%

PRODUCTIVE LABOR

Molding Costs

Item 2	Molders' wages
2	Floor helpers' wages
2	Cleaning and grinding castings
5	Employers' liability for above
3	Materials and supplies used directly by above
	Molders' direct total
	Molders' percentage of overhead—per cent
	Molders' direct and overhead total
	Molders' burden 20% of total of direct and overhead costs
	Molders' gross total

The molders' gross total divided by the pounds of castings sold gives average pound price for molding.
Molders' direct total divided by the hours cost for molders.

Table III

Metal Loss, Sales and Capital

TO ASCERTAIN LOSS OF METAL

Gov. Form No. 1040		Pounds	Price
Item 6	Inventory at beginning of period		
4	Plus metal purchased during period		
8	Total		
	Less inventory at end of period		
	Shows the amount used during period		
	Deduct from the above the amount sold in pounds		
	Balance left is the actual loss		

Divide the weight of castings sold into the amount lost which will give the percentage of loss to add to the cost of metal or alloy to take care of that overhead on metal.

OVERHEADS TO APPLY TO PRODUCTIVE LABOR COSTS

Add together the direct totals for molders, melters, and coremakers then divide into the total of overheads. This will give the percentage of overhead to add to each class of productive labor.

SALES

We have shown on charges for the cost of sales that the Item No. 10 of government report, Form 1040, Schedule B so far as it applies to the cost of sales should be omitted from productive labor overheads and should be added to the gross manufacturing costs and metal costs of the castings.

CAPITAL

The capital necessary to operate a business is as follows:
Inventory value of machinery, tools and fixtures
Inventory value of materials and supplies
Inventory value of products in course of manufacture for sale
Accounts receivable
Balance in the bank and cash

know their costs but only guess at them. In cases where the buyers are employed by a firm that is or has been operating a foundry, but want some castings made outside, they will say that their production costs are so-and-so per pound—far less than the quoted price. The foundryman should find out if they can tell how much capital is invested in their foundry department in tools, machinery and equipment; how much capital was used in carrying the foundry's share of the accounts; how much was charged for rent, bookkeeping, etc., and how much they were willing to accept as a fair profit on everything necessary to produce castings, labor included.

He will find that they don't know, and that they will say anything to get a lower price—even at times give the order to someone who has quoted above the low man to save their face. A pound of castings was never sold to anyone who did not want them, and no matter how much the price is cut no more castings will be bought than the buyer thinks he will need. Cutting prices does not create profits in the foundry but only creates losses.

The United States government has rendered to the business men of this country one of the greatest services they have ever received in setting up a standard method of reporting income. On Form No. 1040, Schedule B, Tables I and II, is the most simple, complete and condensed basis of costs that has ever been published, and it is applicable to every business as a basis from which to figure costs. That it is to be used only as a basis and not as a full system is shown by the government calling for a full explanation of your deductions years after you have filed your reports. For example, the writer has been called upon to furnish explanations of deductions No. 2—Labor; and to show to whom paid, the amount paid to each, the period of employment and the nature of the service rendered. Also on deduction No. 3 he had to show the character of materials and supplies used, the amounts of the items and what class of labor used them. At different times every deduction has had to be explained in detail. What the government calls for is only the necessary data that the foundryman needs to make up a schedule of prices from his actual costs.

By using his government report of the previous year the foundryman can ascertain how much it has cost him to do business and how much he made or lost, and by making divisions of the items in the report into classifications, as shown in the following illustrations, he will have the necessary data from which to compute cost prices. If he has made a loss he should increase those prices. If he has made too much profit he should decrease the prices in the table he computes. To enable him to immediately compare his costs for the previous year with

Table IV

Example of Pound Price List

Molding $4 per hour; Melting 8 cents per pound; Coremaking $2 per hour, 16 molds per 8-hour day

Pounds in 8 hours	Pounds in mold	Molding pound cost	Melting cost	Metal price	Selling price	8-Hour output value	Net profit 10%	Profit 8-hours labor	Profit on metal
1	2	3	4	5	6	7	8	9	10
16	1	$2.00	$0.08	$0.2066	$2.29	$ 36.58	$ 3.66	$3.33	$ 0.33
20	1¼	1.60	0.08	0.2066	1.88	37.77	3.77	3.36	0.41
24	1½	1.33	0.08	0.2066	1.62	38.88	3.88	3.39	0.49
28	1¾	1.14	0.08	0.2066	1.43	40.04	4.00	3.42	0.58
32	2	1.00	0.08	0.2066	1.29	41.16	4.12	3.46	0.66
40	2½	0.80	0.08	0.2066	1.09	43.60	4.36	3.53	0.83
48	3	0.66	0.08	0.2066	0.95	45.60	4.56	3.56	1.00
56	3½	0.57	0.08	0.2066	0.86	48.16	4.81	3.64	1.17
64	4	0.50	0.08	0.2066	0.79	50.33	5.06	3.72	1.34
80	5	0.40	0.08	0.2066	0.69	55.20	5.52	3.87	1.65
96	6	0.33	0.08	0.2066	0.62	59.52	5.95	3.97	1.98
112	7	0.29	0.08	0.2066	0.57	63.84	6.38	4.07	2.31
128	8	0.25	0.08	0.2066	0.54	69.12	6.91	4.27	2.64
160	10	0.20	0.08	0.2066	0.49	78.40	7.84	4.50	3.34
192	12	0.17	0.08	0.2066	0.46	88.32	8.83	4.82	4.00
256	16	0.12	0.08	0.2066	0.41	104.96	10.49	5.20	5.29
320	20	0.10	0.08	0.2066	0.39	124.80	12.48	5.87	6.61
384	24	0.08½	0.08	0.2066	0.37	142.08	14.20	6.30	7.91
448	28	0.07	0.08	0.2066	0.36	160.68	16.07	6.81	9.26
512	32	0.06¼	0.08	0.2066	0.35	179.20	17.92	7.35	10.58
576	36	0.05½	0.08	0.2066	0.34	195.84	19.58	7.68	11.90
672	42	0.04¾	0.08	0.2066	0.33½	225.12	22.51	8.72	13.88
736	46	0.04½	0.08	0.2066	0.33	242.88	24.29	9.09	15.20
800	50	0.04	0.08	0.2066	0.32½	261.28	26.13	9.60	16.53

EXPLANATION OF PRICE TABLE

Column	
1	Shows the weight of output per 8-hour day.
2	Shows the weight in a mold (16 molds per day).
3	Shows the price per pound for molding at $4 per hour.
4	Shows the price per pound for melting at 8 cents per pound.
5	Shows the price per pound for alloy at $0.2066 per pound.
6	Shows the price at which to sell.
7	Shows the price of output per 8-hour day.
8	Shows the net profit on output per 8-hour day.
9	Shows the net profit on labor per 8-hour day.
10	Shows the net profit on metal per 8-hour day.

Coremaking labor is to be added to pound price extra.

EXAMPLE

Weight of casting 50 pounds	Price	$0.32½	per pound
Coremaking one hour $2	Price	0.04	per pound
Casting price	Price	$0.36½	per pound
Weight of casting 10 pounds	Price	$0.40	per pound
Coremaking one hour $2	Price	0.20	per pound
Casting price	Price	$0.69	per pound

his present practice, the columns for money, weight, and hours are left blank and show on the margin the item numbers in the government report where he should find the proper data to assemble in his classifications of production costs.

In addition to the divisions shown for his costs he will need the hours of labor for each classification, the pounds of aluminum castings sold, the pounds of brass or bronze castings sold during the period, the pounds of metal bought, the pounds of metal and price of the inventory at the beginning of the period, and the pounds of metal and price at the end of the period.

If the foundryman assembles his current production cost according to the classifications we illustrate, and combines those charges into the items of the government report, each item can be verified. Production costs simply have been combined and entered into the government report as deductions.

The necessity of making the income tax report has been the means of letting the individual business man of this country know where he stands in the conduct of his business, more than anything that has ever happened. And as the enforcement of this law becomes more stringent and the demand for explanations becomes more searching, the better it will be for business in general, and I am of opinion that in 10 years from now the enforcement of the income tax law will so benefit conditions that few concerns will be found in the condition stated in the federal report, of not earning 1 per cent on the money invested. They will know their costs and sell according to those costs or get out of business.

The accompanying tables indicate clearly the high cost of light castings and the relative cost for heavy castings, also the large amount of capital necessary for the metal account and the necessity of provision for loss on metal as well as the burdens necessary to compensate for interest, lost accounts, discounts, allowances and a profit on the metal.

The profit and price columns show how little per pound it takes to convert the profit into loss and how unwise it is to use one of the common methods of making prices, such as to guess costs, to find out competitors' prices and make a lower price, or to compute the average of production as so many cents over the price of the metal and use that as the price for castings. The latter method gives too low a price per pound for light and too high a price for heavy work. This shows the danger of making flat or average prices to a customer. The use of the average cost of the mold as the basis for price plus the price of the metal is an uncertain system. The number of molds that can be made per day is as varied as the size of the molds and the shape of patterns. Another method is to say that we have to get so many dollars per day, plus the price of the metal, out of each molder. This method will get the pound price on the heavy castings too low, and on light castings too high.

The foregoing methods are easy to compute and were satisfactory in the old days when a brass molder melted his own metal, made his molds and with his helper poured off his work, dumped his molds, sifted sand, and the helper cleaned the castings and made the cores. Then the boss handed out his castings and got his money. Today it is different. The foundry is as specialized as all other businesses are. It has floor molders, tub molders, machine molders, melters, coremakers, floor helpers, cleaners, grinders, machine and shop upkeep men, metal room and pattern loft men, foremen, bookkeepers, etc. The cost system has to take care of those varied and different activities in the production of castings and indicate how to make a price for castings that will pay the foundry owner for the service rendered.

The methods that have been advocated will not increase costs; they will show only what the costs really are and by making out a price table accordingly will show what the prices should be. This may result in some firms having to increase their prices, or part of their prices, to save themselves from loss. It certainly will show, after a careful comparison of the prices in the pound price list, the great difference from the cost per pound for castings controlled by the output per hour, or per mold, and the addition of the cost for melting and for metal. The coremaking cost is to be added to the price list cost. Adoption of this plan will uncover many losses, large or small, that could have been avoided by laying out the mold, and making a right price for the work. For example, a large brass foundry owner paid a visit to us a few weeks ago and as a matter of probable interest we showed him our methods of making prices. We met him the other day and he cited an example of a pattern, among others, to be made in composition and said that he would ordinarily have looked at them and quoted 45 cents per pound. He kept time on the job and found on all of the patterns but one that he would get a fair profit at 45 cents. On that one pattern, from which a large number of castings were made, he found according to his own hour cost for the molding, helping, coremaking, and melting that the cost was $1.08 per pound. From our own experience and others we believe that cases similar to the above are of daily occurrence and are a continual loss in operating a brass foundry.

A. F. A. Co-operates with Testing Society

The American Society for Testing Materials and the American Foundrymen's association, through their governing boards, have reached an agreement on details of co-operation between the two societies with respect to specifications and methods of test of mutual interest. As a first step the American Foundrymen's association will be elected to membership on those American Society for Testing Materials committees dealing with materials in which the Foundrymen's association is interested. The committees of the Foundrymen's association will function by reviewing standards of the Testing society, either recommending endorsement or submitting criticism. In the case of tentative standards, endorsement will be deferred until their adoption as standard, and in the meantime any criticisms will be submitted to the Testing Society's committees. Should the Foundrymen's association desire to publish the Society for Testing Materials standards it has endorsed, the publication will take the form of such an endorsement, the standards being printed under the Testing society's titles.

The Foundrymen's association is now represented on committees of the American Society for Testing Materials as follows:

A-1 on Steel—A. H. Jameson.

A-3 on Cast Iron—H. B. Swan.

A-4 on Heat Treatment of Iron and Steel—H. A. Neel.

A-5 on Corrosion of Iron and Steel—H. Y. Carson.

A-7 on Malleable Castings—Enrique Touceda.

B-2 on Non-Ferrous Metals and Alloys—L. W. Mueller.

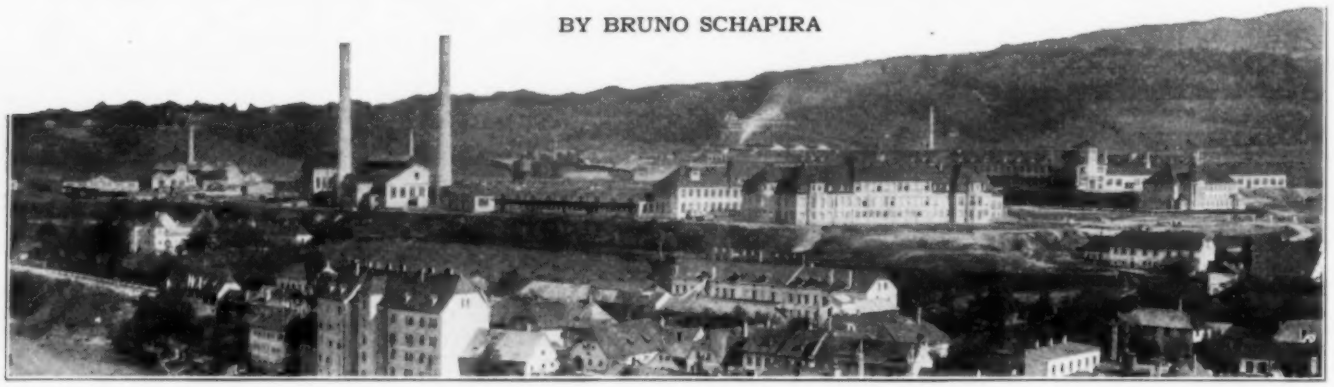
D-5 on Coal and Coke—R. S. MacPherran.

E-4 on Metallography—H. A. Schwartz.

The Foundrymen's association has asked for membership on committee C-8 on refractories.

Modern Foundries of Central Europe–II

BY BRUNO SCHAPIRA



THE Leobersdorfer Engine Co. possesses a gray-iron foundry chiefly to supply the needs of its steam and oil engine factory. The company also operates a chill-casting shop producing various chill castings, especially Griffin-type car wheels. For many decades this plant also has specialized in the construction of water turbines and diesel engines, especially large ones, the gray-iron foundry being particularly adapted to this sort of work. The molding room has a working area of 165 x 196 feet. It is divided into four longitudinal bays. One of these bays is illustrated in Fig. 12 in the present installment of this article. Two of the longitudinal bays are specially designed for molding heavy pieces, each floor being served by two traveling cranes with a capacity of 11 tons each. The two other bays are equipped with a number of jib cranes. Although quantity production methods are carried as far as possible, such methods cannot be applied successfully to the construction of big engines, preference in general being given to hand molding, with ample use of templet and sweep molding. The heaviest pieces cast have a weight of from 30 to 40 tons, the cupola furnaces being am-

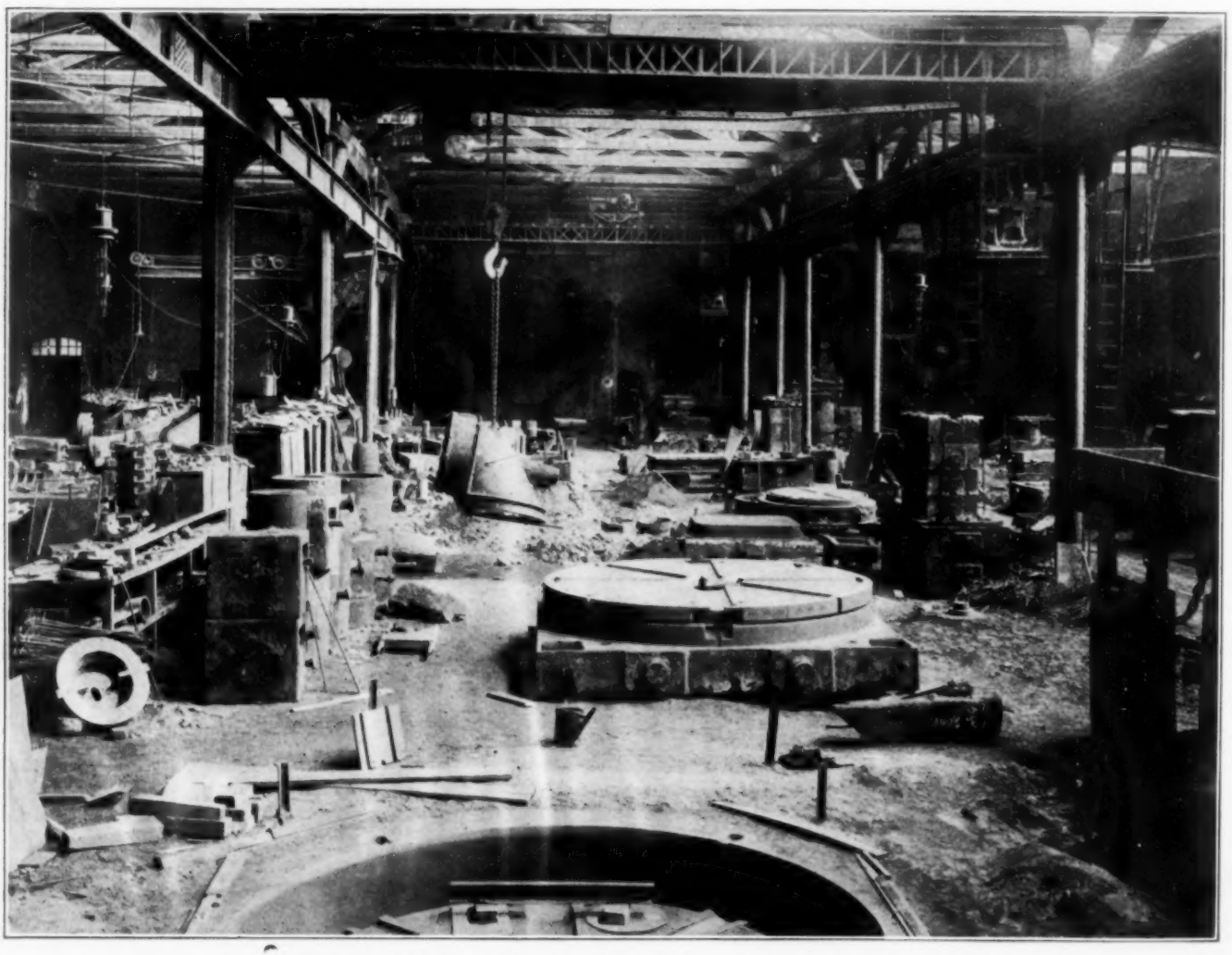


FIG. 12—HEAVY WORK FOUNDRY OF THE LEOBERSDORFER MACHINE WORKS

ple for these requirements. Fig. 13 shows various castings representing the most important work of this foundry.

A separate small cupola is provided for special castings. The metal from this furnace is used for those parts of diesel engines which are subject to pressure up to 2000 pounds per square inch and which, therefore, require special density. No doubt, the construction of diesel engines has resulted in great demands being made on gray-iron foundrymen, first of all as regards those parts of the air compressor which have to resist pressures up to 2800 pounds per square inch, then as regards those parts in the cylinder exposed to the combustion of the oil, especially the tops of the pistons. In addition the cylinder walls themselves as well as the pistons must be absolutely solid and close grained, without any blow holes.

Motor-car wheels and acid-proof castings also are produced in the Leobersdorfer foundry. The output of the entire foundry amounts to 3000 tons per year. The Griffin-type car wheels are made in the chill casting department. The daily output is 100 wheels. Circular floors are used, served by electric jib cranes. The molds are made in the forenoon and cast in the afternoon, after which the finished wheels are put into cooling pits for annealing. The Austrian and Czech railways take most of the wheels. The railways obtain favorable prices by trading in their old wheels which average 16 years' wear. Another section of the chill-casting foundry produces various other castings, such as rollers, hammers, anvils and machine parts.

FIG. 14—TYPICAL MALLEABLE CASTINGS FOR AUTOMOTIVE ENGINES

As in other foundries, skeleton patterns are used for large jobs. The methods are different but in many ways resemble those of western foundries. For the retort, Fig. 16 and the double-bend, Fig. 17, the skeleton patterns shown in Figs. 18 and 19 are used. These frames serve both for the molds and the cores. One of the advantages of the skeleton pattern lies in the saving of space in the pattern storage. This type pattern is not distorted or shrunk even when put aside for several years.

The base of the skeleton pattern shown in Fig. 18 is formed by the guiding frame *A* joined by cross pieces. Its interior edge corresponds to the exterior outline of the casting and the outer edge serves to guide the molder. An additional piece which has a length of about 8 inches from flanges *B* and *G* to the cross piece, is developed into the core bracket by proper templets. The flanges *B* and *G* are sunk into the frame, the auxiliary bows *C*, Fig. 18 being merely for the purpose of supporting the ribs, each of which is fixed with a screw. The auxiliary bows *C* and *E* of the double bend frame, Fig. 18, serve as guides for the molder. As these auxiliary wooden parts are thicker than the walls of the castings, the space made in the sand must be covered later by a suitable cope.

When molding the retorts, the lower part of the skeleton pattern first is embedded in the loose sand in the pit. The core bed is formed by the sweep, Fig. 20. A section of the core bed is shown in Fig. 21. The core bed having been formed and blacked, the sand surfaces are covered lightly with dry sand to prevent the bed-sand sticking to the core when the latter is taken out. The upper part of the core is developed by means of a templet, Fig. 22. Fig. 25 illustrates a section of the mold and core made according to the method just described. A sand layer 31 inches in thickness, equivalent to the metal section is shaved

FIG. 13—ERECTING SHOPS OF THE MACHINE WORKS SHOWN IN FIG. 12

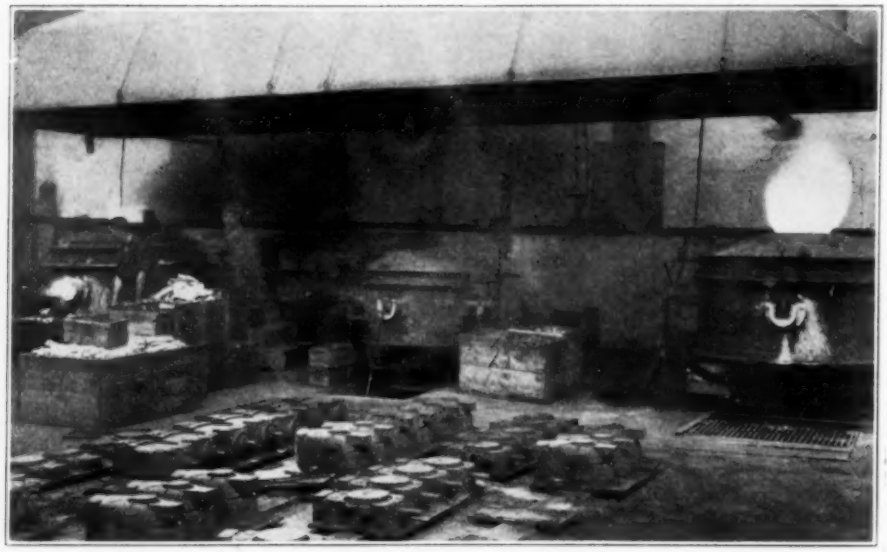


FIG. 15—OIL-FIRED ALUMINUM MELTING FURNACES

off the sand-pattern. This being done, the core is ready to be lifted out, as indicated in Fig. 23. Then the sand layer in the part which has been the core bed is removed in the same way as that on the upper half of the core to obtain the correct outer dimensions of the casting.

The method of molding the double bend is the same in general. The shaving down of the sand layer with the templet to obtain the correct thickness of iron must be given special attention. It is most satisfactory to use a sweep made of sheet iron according to Fig. 24. The sand streaks which remain are cut away by a skimmer. The use of this templet or sweep is most advantageous. The fact that with its wings bent around it fits the surface of the sand-pattern exactly, so that the latter serves as a guide, makes it certain that the casting will be of uniform thickness. This is not always the case if a big core of complicated shape is made in a core-box. One may be sure that a core made as a part of mold itself will show the same deviations as the mold. The result will be no great uneveness in the thickness of the iron in the different places.

Foundry of the Andritz Company

The Andritz company's works is one of the most prominent in Austria in the steam, heavy gas-engine and water-turbine fields. This company has a large gray-iron shop and also a steel foundry. The gray-iron foundry makes castings weighing up to 50 metric tons. It has an output of 2500 tons per year. As shown in Fig. 28 it consists of two bays, 157 and 187 feet in length respectively and 41 feet in width. These are used for molding and adjoining bays on each side serve for making medium and small sized castings. There are two 20-ton electric traveling cranes in one of the bays, with one similar crane in the other. The melting plant comprises two cupolas with a combined hourly

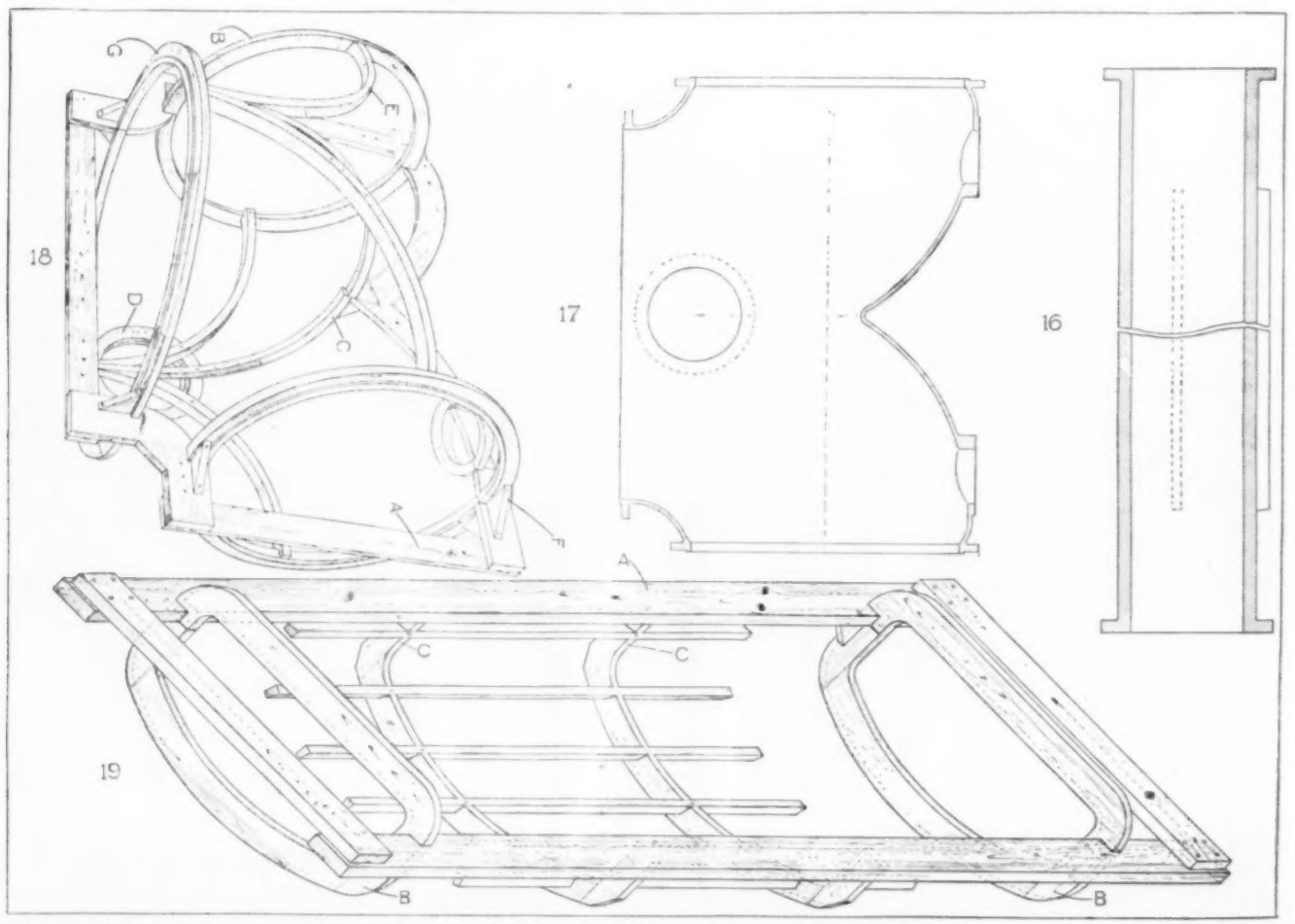


FIG. 16—RETORT IS MOLDED FROM SKELETON PATTERN FIG. 17—DOUBLE BEND PRODUCED FROM SKELETON PATTERN SHOWN IN FIG. 18 FIG. 19—PATTERN FOR RETORT CASTING SHOWN IN FIG. 16

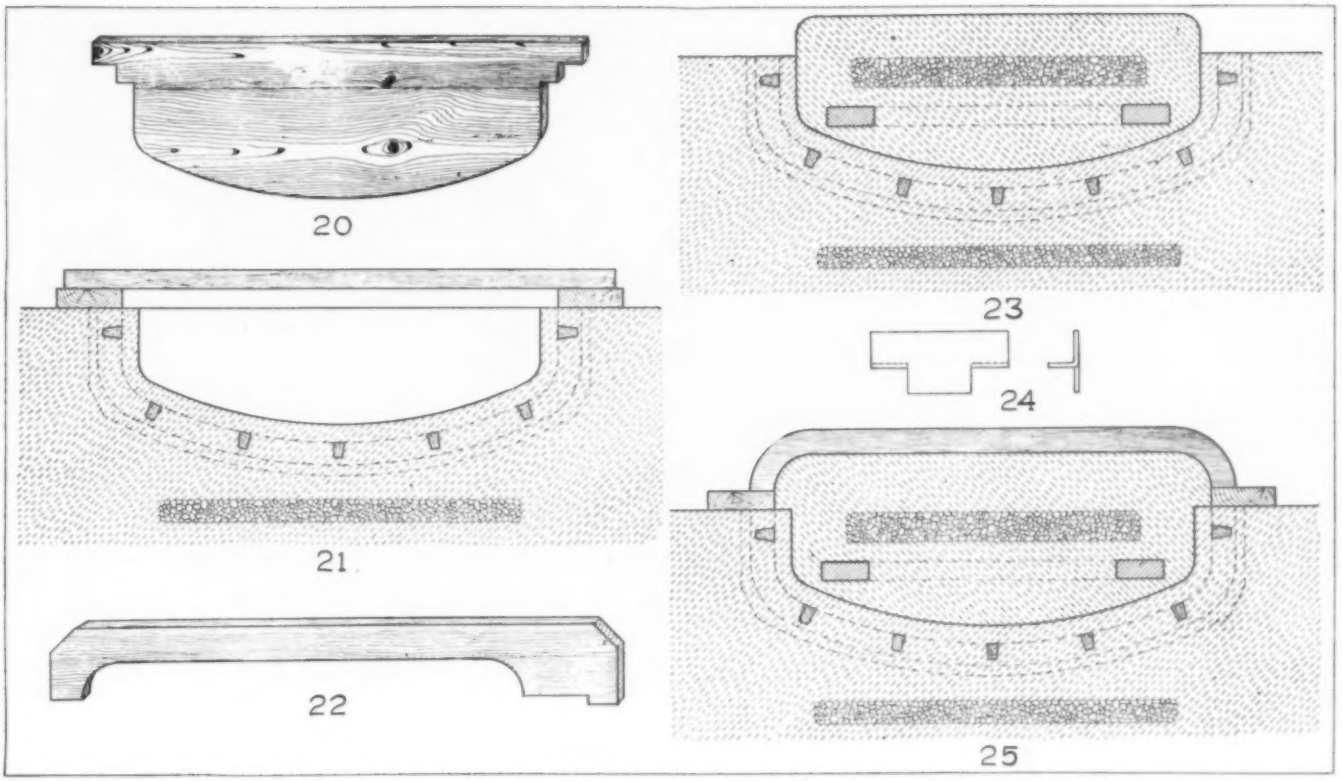


FIG. 20—SWEEP FOR RETORT MOLD FIG. 21—SECTION OF CORE BED FOR RETORT FIG. 22—TEMPLET FOR THE CORE FIG. 23—COMPLETED CORE FIG. 24—IRON SWEEP FOR DOUBLE BEND FIG. 25—SECTION THROUGH MOLD AND CORE FOR RETORT CASTING

output of 9 tons. The cupolas must be operated for six hours to accumulate the metal for a 50-ton casting. At present a blast-furnace blower for the Alpine Montan Gesellschaft is being constructed, which will be part of one of the largest blowing-engine plants in Europe.

A large amount of sweep-molding

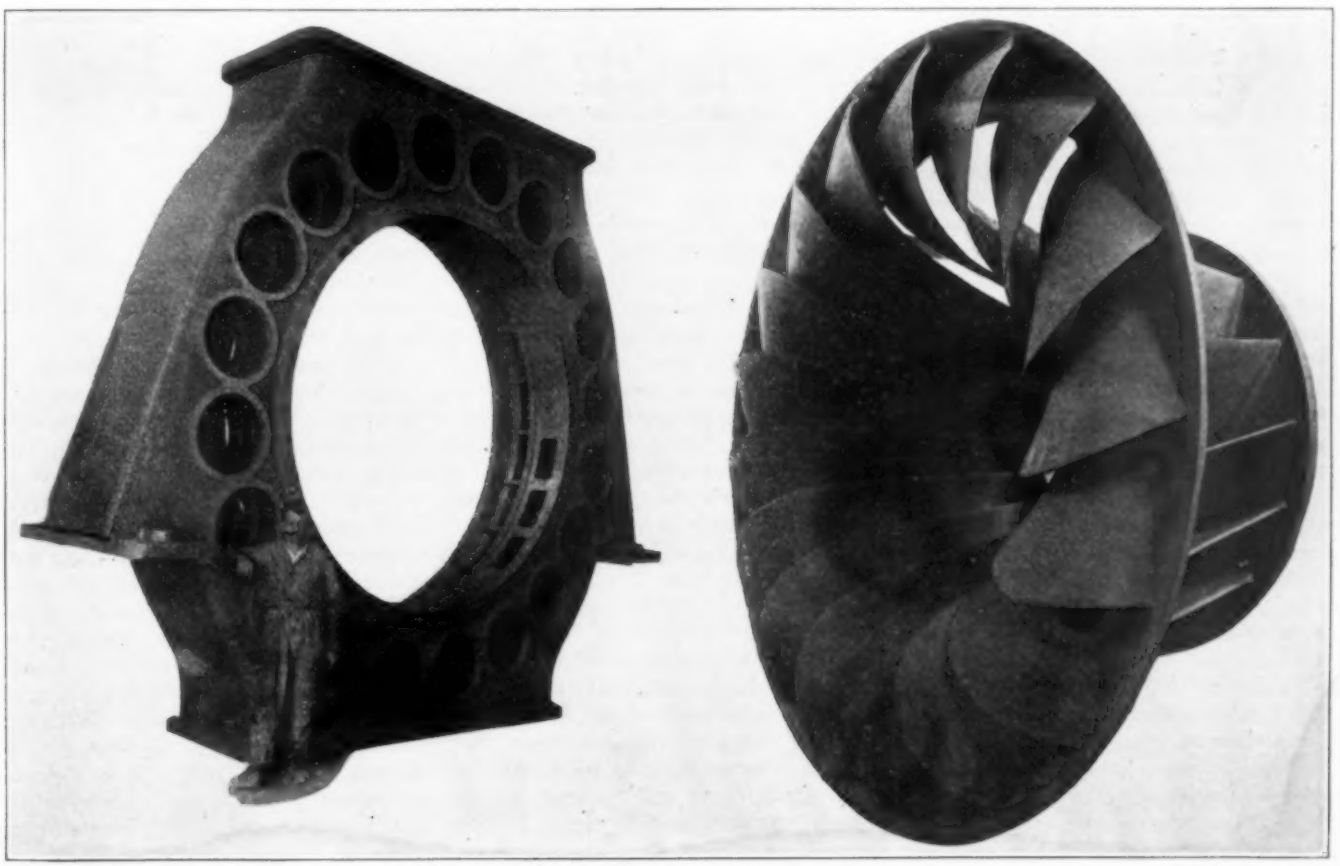


FIG. 26—VALVE BOX FOR A 2500-HORSEPOWER FURNACE BLOWER FIG. 27—ROTOR FOR A WATER TURBINE CAST IN ONE PIECE

is done in this foundry. Large valve boxes such as is shown in Fig. 26 are molded by sweeps. The dry-sand molds are dried in ovens which are internally fired with step grates using brown coal. The largest drying oven has double doors 10 x 16 feet, one of which leads into each molding bay. Molds which are too large to be moved are dried by portable hot-air blowers. The molding sand is obtained from a sand pit close by. Figs. 26 and 27 show examples of gray-iron castings of a large size made at the Andritz foundry.

Five molding machines with turnover tables, a jar-ramming machine and an electrically driven machine are used for making small castings.

The cleaning room for the large castings adjoins one of the large foundry bays and is served by the same crane. It is situated in such a way as to connect directly to the molding floors on the one hand and the machine shops on the other.

Three flask store-rooms in which the flasks are stored according to size are connected with the foundry. There are also three large pattern store houses, the dimensions of which are 65 x 260 feet, each with several floors. Storage space thus is provided for over 100,000 patterns.

The power for the foundry is furnished partly by a small gas-engine station and partly by a water turbine. The gas engines are supplied by three producers. A waste-heat boiler is installed in connection with the gas engines. The steam thus produced is used to heat the glue pots in the pattern shop and for other purposes.

The Andritz steel foundry makes castings weighing up to 1½ tons. There are two molding floors each traversed by an electric crane. The converter and cupola are in a wing off the main foundry. The melting capacity is 1½ tons per hour. Most of the molding is done by hand. The equipment includes cold saws for cutting off riser heads and a sand-blast plant. An annealing furnace with a removable roof also is provided. The two mold drying ovens, as in the gray-iron foundry, are adapted for internal firing with lignite coal.

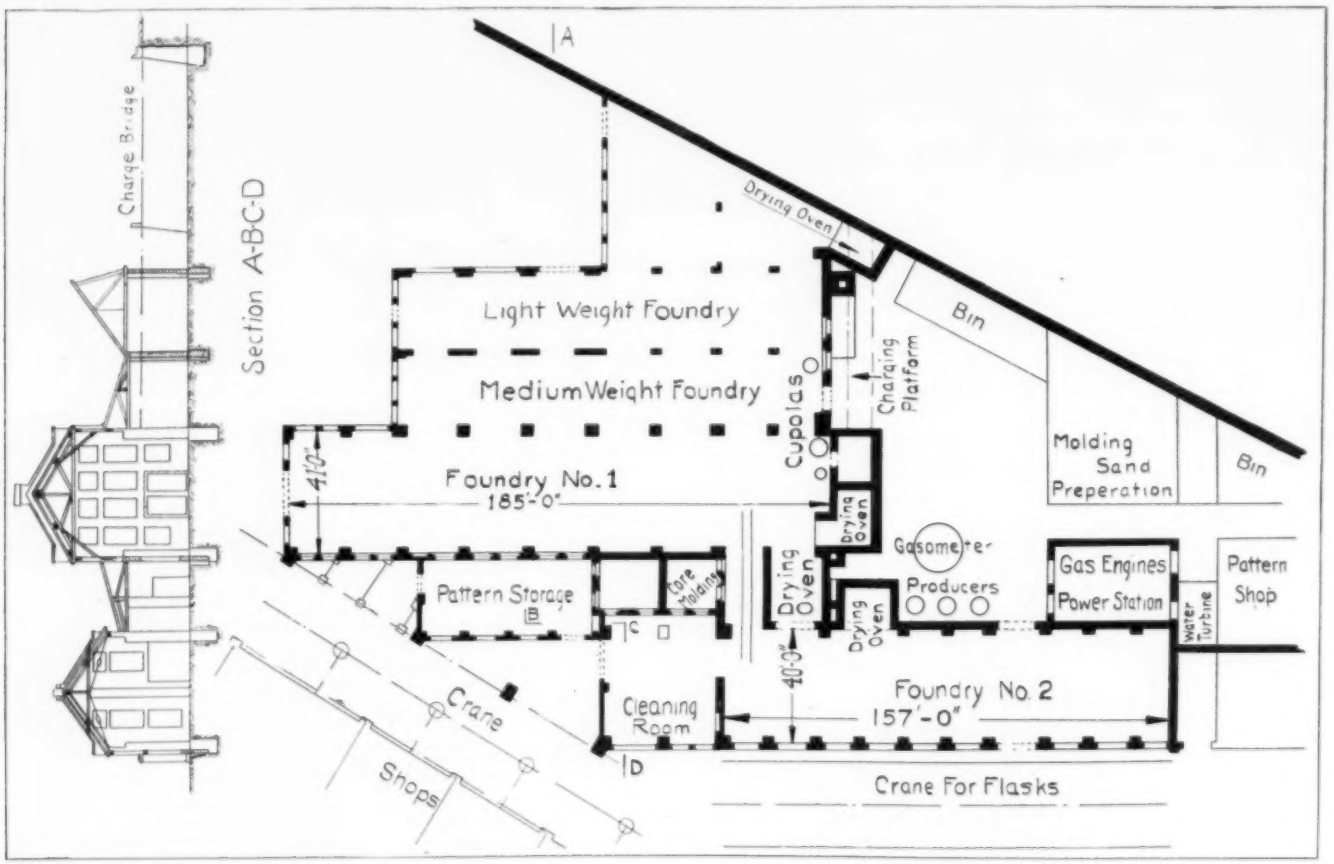


FIG. 28—LAYOUT OF THE IRON FOUNDRY OF THE ENGINE WORKS AT ANDRITZ

The Steel Foundry in Leobersdorf

Another interesting steel foundry is found in Leobersdorf. It was built in 1917 as a part of an ammunition factory and when the war was over it was adapted to the production of mild steel ingots and castings for the rolling mill in Traisen owned by the same firm.

This plant operates two open-hearth furnaces with a capacity of 12 tons each, only one of them being worked at a time. The weekly production is 350 tons for each furnace. The plant also includes a 6-ton Heroult electric furnace which, however, is not in service for the present on account of the high cost of electric power. The electric furnace is supplied with 3000-volt current. A rolling mill is joined to the open-hearth plant. The molding floor for castings also is near the open-hearth furnaces. The castings turned out weigh from 100 to 4400 pounds.

The open-hearth stock-yard is served by a 7½-ton magnet crane. It fills the charging boxes which have a capacity of 1½ tons each. A separate crane carries the boxes to the furnaces. The gas is produced by four rotary-grate producers with a diameter of 7½ feet, two of the producers serving a furnace at one time. The coal bunker has a length of 300 feet, a width of 43 feet and a depth of 19 feet. It is spanned by a traveling bridge carrying a 3-ton grab bucket used for feeding the producers.

The furnace room is directly connected with the molding floor which is served by a 25-ton foundry crane and a 5-ton ingot crane. The molding floor is equipped with one small and four large hydraulic molding machines. The output of the foundry amounts to

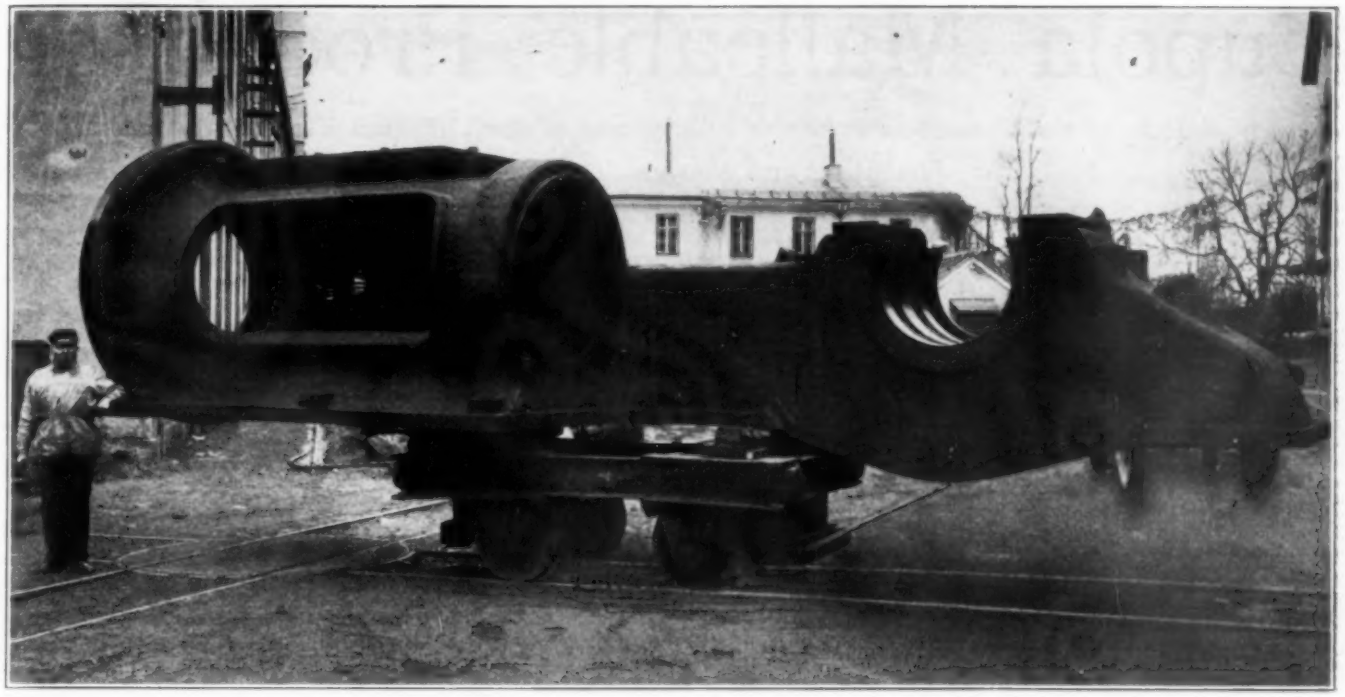


FIG. 29—FRAME FOR A 12,000-HORSEPOWER STEAM ENGINE CAST AT THE FOUNDRY IN ANDRITZ

30 tons per week. A complete sand-preparation plant is provided. It consists of a ball mill, a disintegrator and a shaking sieve, driving power being supplied by a 25-horsepower electric motor. The core-molding shop and the air compressors are located alongside the sand-dressing plant.

In the cleaning room there are four cold saws and a 75-horsepower compressor for supplying air at seven atmospheres pressure. The cleaning room is served by two cranes.

At St. Poelten is an interesting combination foundry. It produces steel castings, malleable-iron castings, chill castings and ordinary gray-iron castings. Steel and malleable iron castings constitute the bulk of the output, including wheels for freight cars. Miscellaneous castings weighing from 2 pounds to a ton also are made, including railway materjal and automobile parts. The production of thin-walled electric-steel castings is one of the specialities of this plant. Synthetic gray-iron made from scrap in the electric furnace likewise has been produced with success. For this work ferro-silicon is added in closed vessels in order to prevent waste. Malleable iron is made in the electric furnace. It is claimed the electric-furnace malleable can be annealed in 25 to 30 per cent less time than ordinary air-furnace metal. The electric furnaces have a capacity of 1½ tons each and are supplied with 3-phase 25-cycle current at 220 volts. Cupola malleable also is made and is more expensive than electric-furnace malleable, cheap water-power being available. The electric foundry is operated 24 hours a day in three shifts.

The electric foundry has five molding floors three of them being served by cranes. The larger castings are molded by hand and the smaller ones on machines. Molding machines with rollover tables, two large hydraulic machines and two jar-ramming machines are provided. A core-molding shop and an up-to-date sand dressing plant adjoin the molding floors. Two annealing furnaces are provided. The heads and risers are cut off either with oxygen or by cold saws or planing machines.

Research Group Meets

Reports of progress being made on researches conducted by the organization on annealing, core practice, facing practice, furnace practice and the elimination of slag from castings were made at a recent meeting of chief executives and operating officials of the companies comprising the Electric Steel Founders' Research group, held at Wernersville, Pa. It was stated that there has been gratifying progress in each group investigation and that the increased volume of business at present affords a better opportunity for the prosecution of certain researches than when the operations were curtailed in 1921. The group members report that the standardization of practices recently has been extended to cover methods of chemical analysis.

Silica Brick Production

According to a recent report published by the United States geological survey, the production of silica brick has made great progress during the last ten years. The silica brick produced in the United States from 1911 to 1920 is shown in the following table:

		Value
1911	104,483,000	$ 2,520,816
1912	135,578,000	2,923,174
1913	174,246,000	3,815,806
1914	129,693,000	2,951,525
1915	130,244,000	3,039,869
1916	232,673,000	6,369,256
1917	327,030,000	15,510,595
1918	336,562,000	19,987,803
1919	211,420,000	10,914,898
1920	250,582,000	15,076,821

In 1920 silica brick was reported from 12 states, Maryland increasing the total by one over the report in 1919. The states reporting in 1920 were Alabama, California, Colorado, Illinois, Indiana, Maryland, Missouri, Montana, Ohio, Pennsylvania, Utah, and Washington. Pennsylvania was the leading state in production reporting the equivalent of 182,811,000 9-inch brick, valued at $10,629,769, an increase of 22,753,000 brick and of $2,787,453.

Illustrates Pipe Casting

Richard Moldenke, Watchung, N. J., read a paper on engineering aspects of cast iron, at a meeting of the New England Water Works association at the Boston City club, Nov. 14. Dr. Moldenke showed motion pictures of the process of casting iron pipe, taken at the new plant of the United States Cast Iron Pipe & Foundry Co., Birmingham, Ala.

H. P. Kreulen, Bethlehem Steel Co., Bethlehem, Pa., spoke on iron mixtures for foundry use before the Wisconsin Foundrymen's association, Nov. 28, at the Hotel Pfister, Milwaukee.

Cupola Malleable Production

Effects of the Constituents of the Charge and of the Different Elements in the Metal Are Discussed and Method for Calculating the Charge Is Detailed—High Annealing Temperature

BY C. C. HERMANN

THE cupola process for producing malleable iron is the cheapest in first cost and, due to the high melting ratio possible, is more economical than other processes in fuel costs. As the product generally has a lower tensile strength than malleable iron produced by the other processes, it is used only for light sections such as pipe fittings where a high tensile strength is not an essential.

The cupola for producing the white iron is not necessarily unlike the gray-iron cupola. A single deck of tuyeres is preferable; set low so that the metal will not be cooled appreciably in passing through the fuel bed at a temperature lower than the melting zone. The air-blast pressure ranges from 8 to 10 ounces per square inch. The tuyere area is at least 35 per cent of the cross sectional area of the melting zone, and so arranged that the air may expand internally. This internal expansion permits the reduction of the air velocity to more nearly conform to the resistance of the charge. The usual chilling of the slag that forms on the coke directly in front of the tuyeres is thus avoided. A high blast within the cupola chills the slag causing it to bridge, and in addition the higher blast increases the loss of silicon in the charge.

Successful operation of long heats depends on the removal of slag. If the slag is allowed to accumulate to a level where the entering blast strikes it, chill will be encountered. In case the tuyeres are too high, an excess of fuel will be used and the metal will not be as hot as if melted in a cupola with lower tuyeres. The slag must be kept fluid by adding the proper amount of flux, generally 1 to 3 per cent of the weight of the iron. If the iron is clean; that is if the gates and sprues have been rattled to remove the sand and the scrap is not excessively rusty, the smaller amount of flux will suffice. In that case the flux may be put on about the third charge and then every second charge thereafter. Limestone containing about 90 per cent calcium carbonate and about 5 per cent silica and alumina makes a good flux although clam shells, chalk and marble are also satisfactory. It is advisable to leave the slag hole open after the first tap of the slag.

Refuse Coke on Last Charge

At the end of the heat, the bottom of the cupola is dropped as in the gray-iron foundry. If the refuse coke from the last dump is thrown into the cupola on top of the last charge, the slag may be kept sufficiently fluid to clean out well upon dropping the bottom. The dump may be cooled with a stream of water until there is not danger of fire and left over night. The refuse is broken up and the larger pieces of iron picked out by hand. The balance is put through a cinder mill or magnetic separator where the iron is separated from the refuse.

The cupola loss generally runs a little higher than found in gray iron foundries due to the lighter sections of the scrap and to the quantity of steel used.

When using the cupola the heat can be ended at any time by discontinuing the charging, or in case of an emergency by dropping the bottom. When the refuse coke from the previous heat is thrown upon the last charge for the day, the slag is kept liquid and when the bottom is dropped, the cupola cleans well.

The iron and fuel charged alternately pass through the melting zone in contact, and in case light sections, scrap, steel or annealed metal is charged, burning is apt to result. Burnt iron comes out sluggish, makes the castings full of small pin holes and generally causes trouble in the anneal. It is recognized by a brown smoke coming off the surface of the metal in the ladles. Oxidation of the iron occurs freely when an excess of oxygen is at hand. However, if the charge is melted at the proper point in the cupola, where the oxygen of the air has been used in combining with the carbon of the fuel, giving either a reducing or neutral flame the iron will not be burned or oxidized. Numerous tests made by the U. S. bureau of mines show this region to be located at a point about 19 inches above the tuyeres in a 36-inch cupola when using 1000 cubic feet of air per minute. This section of the cupola is the point of highest temperature and indicated by the lining which is eroded excessively at this zone. The coke charge should be such as will confine the melting to a few inches above this region.

The metal charge is made up of pig iron, hard scrap, annealed scrap and steel scrap. Pig iron used in the production of malleable may be either charcoal or coke iron. It is often a problem as to determine what iron to stock and in what quantity. Ordinarily four grades of iron, with respect to silicon, are all that need to be carried, and for light sections such as agricultural castings these may be carried in about the following proportions:

Per Cent Silicon	Proportion of Stock
1.35 to 1.60	⅛
1.10 to 1.34	½
0.85 to 1.09	¼
0.605 to 0.84	⅛

In this iron the manganese should range from 0.40 to 0.80 per cent, and the phosphorus from 0.10 to 0.225 per cent. Sulphur should not go above 0.05 per cent.

The iron should be kept separate in the yard and identified by the car number or other distinguishing mark. Pig iron today is purchased on the basis of furnace analysis and it is advisable to identify each purchase by the car number in which it is shipped. The car number either should be painted on several of the pigs in the pile or put on a board posted over the pile. After the iron has been received and before unloading, if possible, sample pigs should be taken from the car and drilled. At least six pigs should be selected from various parts of the car. The drillings from each pig should be kept separate and equal amounts sufficient to make an ounce sample taken from each. The sample of drillings should be analyzed and this analysis compared with the furnace analysis before final acceptance of the iron, to avoid possible acceptance of iron unfit for malleable.

Hard scrap should be cleaned off all molding sand in tumbling barrels

before being again charged as this reduces the dirt, producing cleaner castings, and saves fuel. Such hard scrap, in case more than one cupola is in operation, is always mixed thoroughly to avoid returning all scrap from separate charges into a single new charge. In case a charge was burned and the scrap from that charge returned in a mass, the resulting charge would be defective, whereas a small quantity of bad scrap may not affect the charge appreciably. The following figures indicate variations of different kinds of scrap from a number of cupola heats:

	Per Cent
Sprue	13 to 20
Over iron	10 to 20
Reclaimed iron	4 to 10
Rejected castings	1 to 7
Cupola loss	7 to 12

Annealed scrap is a questionable element to introduce into the cupola. The most satisfactory method of disposing of it is to run it into annealing pots. A small percentage of anneal, say 2 to 3 per cent may be thrown into each charge, but should rarely exceed this amount, and this percentage should replace an equal amount of steel scrap. Annealed scrap is generally rusty and this rust tends to make the iron gassy and the castings are liable to have pin holes just under the skin, which do not show up until after the castings are annealed or have been partly finished. This adds machining expense to foundry expense and makes the cost of rejection high.

Steel scrap as used in cupola malleable may be the general run of scrap including steel plate shearings, and other small sections. It is preferable to have the scrap cut up into pieces small enough to be charged without making a tangled up mess in the cupola. If the sections are too small, say ⅛ inch thick by 1 inch wide the steel oxidizes readily and the cupola loss will be increased. At the market price of steel scrap a saving generally is accomplished by its use.

Cupola metal must be poured even more rapidly than furnace iron and, therefore, the gates must be amply large accompanied by larger sprues. Iron high in steel cools quickly and must be handled rapidly. In many cases the molder must fairly throw the iron into the molds. Burned iron becomes sluggish upon cooling ever so little.

Several changes in carbon take place in the iron when melted in the cupola. The net result may be a gain or a loss in carbon depending on cupola conditions and the original composition of the iron. If the temperature of the iron is high and the charge of fuel small, more carbon will be burned out than gained from the fuel. Again, if the iron is hot and remains in contact with the fuel a longer time, more carbon will be picked up than is lost.

The effect of silicon is to prevent the carbon from going into solution with the iron to form iron carbide. As an example a heat having 1 per cent of silicon with other elements normal will produce white iron in castings up to ¼ inch thick. In sections from ¼ to ½ inch thick, the fracture will be mottled in appearance, and for over ½ inch thickness, the castings will approach gray. For ordinary castings ½ inch thick the silicon may fluctuate between 0.45 and 0.75 per cent. In passing through the cupola a loss of silicon is experienced due to oxidation. This loss depends on the initial silicon content of the charge. For silicon around 1 per cent the loss amounts to nearly 0.25 per cent.

Phosphorus Kept Within Range

Phosphorus seldom causes trouble in the malleable mixture due to the low-phosphorus pig iron used. It should range from 0.15 to 0.225 per cent. Castings having more than 0.225 per cent phosphorus are liable to crack and warp, and if this element goes much below 0.15 per cent the iron will not be fluid enough to pour the smaller castings.

Sulphur weakens the iron, and castings high in sulphur are liable to crack due to their inability to resist the high internal stresses. Therefore, sulphur should be kept low. The charge gains sulphur during melting from the fuel and some sulphur is removed by the manganese which combines to form manganese sulphide. Also shrinkage in the castings is increased by increases in sulphur. A higher temperature and a longer time is required to anneal iron high in sulphur. Just how high it is practical to go with the sulphur element and still obtain passable castings is difficult to ascertain. The writer has witnessed heat after heat of cupola malleable poured and annealed with sulphur between 0.20 and 0.25 per cent. This iron had a considerable quantity of steel in it and the fracture was a dark gray. When taken from the anneal the castings would stand nearly as much twisting as air-furnace malleable and proved to be sound. However, it is not considered advisable to have the sulphur this high for straight production work, a safer limit being in the vicinity of 0.10 per cent.

Manganese when over 0.40 per cent makes annealing difficult. This element should be about three times the sulphur content. Pig iron containing over 0.8 per cent manganese is rarely used for the cupola process as it is practically impossible to remove an excess of manganese. Manganese unites with sulphur to form manganese sulphide part of which is removed with the slag. However, it is not good practice to use manganese expressly for this purpose. The better method of obtaining a low-sulphur product is to use low-sulphur pig iron and fuel. If the sulphur once gets in the iron, it is difficult to reduce the percentage due to remelting the gates, sprues and over iron produced from day to day. To lay aside this daily production of hard-iron scrap to start with fresh pig is costly so it is necessary to be on guard to see that sulphur is within bounds.

The amounts of the elements are found to vary within certain limits throughout a heat. Below are given the analysis of a series of test bars from heats produced by the cupola process.

No.	Ladle No.	1	2	3	4
1	Silicon	1.30	1.00	1.16	....
1	Manganese	0.27	0.25	0.25	....
1	Phosphorus	0.182	0.193	0.184	....
2	Silicon	0.98	0.94	1.05	1.18
2	Manganese	0.23	0.23	0.22	0.28
2	Phosphorus	0.152	0.204	0.208	0.247
3	Silicon	0.85	0.87	1.05	....
3	Manganese	0.26	0.26	0.26	....
4	Silicon	1.03	0.88	1.27	....
4	Manganese	0.30	0.30	0.24	....
5	Silicon	0.89	0.95	....	0.98
5	Manganese	0.24	0.24	....	0.26

As the first step in calculating the charge the size of the charge must be determined and this depends on the size of the cupola. It should probably be mentioned here that the iron should be tapped into a bull ladle and not directly into hand ladles. This may be better understood when it is explained that the light sectioned scrap melts before the pig iron does, therefore, should the iron be tapped directly into hand ladles it would vary from one ladle to the next. Thus it is important that the iron be tapped into bull ladles large enough to receive the charge, but it must be handled quickly. Even when tapping into the bull ladle, the iron is subject to stratification and a slight wabbling will help toward a more uniform mixture.

For a cupola lined to 36 inches a 500-pound charge is used and this is tapped off into 500-pound capacity bull ladles set on trunnions in front of the cupola spout. When a charge is

Table I

Record of Pig Iron Stock

Car No.	Silicon Per cent	Silicon Pounds per ton	Manganese Per cent	Manganese Pounds per ton	Phosphorus Per cent	Phosphorus Pounds per ton	Sulphur Per cent	Sulphur Pounds per ton
32402	0.99	19.80	0.61	12.20	0.215	4.30	0.032	0.64
21312	0.90	18.00	0.52	10.40	0.157	3.14	0.047	0.94
31206	1.32	26.40	0.41	8.20	0.205	4.10	0.031	0.62
23204	1.21	24.20	0.50	10.00	0.185	3.70	0.033	0.66
47210	1.45	29.00	0.43	8.60	0.192	3.84	0.034	0.68

melted down the cupola is tapped and the entire charge run into the bull ladle from which it is poured into the hand ladles. The foundryman will group his lighter work close to the pouring spout so as to get the metal into the molds at as high a temperature as possible, the heavier work being located farther away. The bull ladle may be mounted on truck to be run on a track, or hung on trolleys which will facilitate carrying the iron to the floors at some distance from the cupola.

For rapid calculation of the charges all pig iron on hand is kept on record and the pounds of each element for each ton of iron are figured. The analysis as returned by the chemist is used in preference to the furnace analysis for these calculations.

All hard scrap is calculated of the analysis for the heat from which it was produced. In case the analyses are not made by the foundry chemist, but must be sent away, and the reports are not received in time for the next heat, two procedures are open to the foundryman. He may delay the use of his scrap, sprues, etc., by placing it in bins, and use the previous days production for the heat; or he may charge the scrap, sprues, etc., in at his calculated analysis for the previous days heat.

The process of calculating a heat of cupola malleable of the following composition may now be considered.

	Per cent
Silicon	0.75
Manganese	0.30
Phosphorus	under 0.225
Sulphur	under 0.07

The charge is to consist of 15 per cent steel having the following analysis:

	Per cent
Silicon	0.00
Manganese	0.50
Phosphorus	0.080
Sulphur	0.080

Also 30 per cent of foundry hard scrap is used including sprue and some over iron cleaned of all sand having the same analysis as the heat from which it was produced, as follows:

	Per cent
Silicon	0.732
Manganese	0.243
Phosphorus	0.215
Sulphur	0.065

The remaining 55 per cent of the charge is to be pig iron selected from stock of the composition as shown in table 1.

The size of charge is 500 pounds making a distribution of charging materials as follows:

	Per cent	Pounds
Pig iron	55	equals 275
Foundry scrap	30	equals 150
Steel scrap	15	equals 75
Total		500

The total elements desired in the hard castings on a per charge basis can be determined as follows:

	Per cent	Pounds
Silicon	0.75	equals 3.75
Manganese	0.30	equals 1.50
Phosphorus	0.225	equals 1.125 max.
Sulphur	0.07	equals .35 max.

Now it is necessary to take into consideration the melting ratio in order to find how much sulphur may be absorbed by the iron from the fuel in melting. Let us assume that the coke contains 0.60 per cent sulphur or 12 pounds per ton and that the amount of coke between charges is 110 pounds. Then there would be 0.66 pounds of sulphur present in each charge of fuel. The amount of this sulphur absorbed by the iron depends on cupola conditions, however, 20 per cent absorption would be as low as is apt to be encountered in good practice. The amount of sulphur absorbed from the fuel would therefore be 0.132 pounds per charge of 500 pounds.

Now if the amounts of the different elements supplied by the steel and foundry scrap are put down and totaled and these totals substracted from the amounts desired the weights to be supplied by the pig iron are found as shown in Table I.

Dividing 3.95, the pounds of silicon to be supplied by the pig iron, by 275, the weight of pig iron on a charge, we find that we must have pig iron of 1.40 silicon. Looking over the irons, Table I, on hand we find that car number 47210 has iron with 1.45 per cent silicon. This then can be used providing the other elements are within bounds. Calculating the same as for silicon 1.06/275 equals 0.385 per cent manganese; 0.742/275 equals 0.27 per cent phosphorus. 0.1518/275 equals 0.055 per cent sulphur. As the iron in car number 47210 meets these requirements it can be used, and the mixture calculations can be completed as shown in Table II.

A temperature of from 200 to 300 degrees Fahr. higher than that used for air-furnace malleable is required to anneal cupola malleable. Due to this higher temperature, many light sections are liable to be burnt in the annealing unless proper protection is provided such castings in the packing. The hard castings are packed in the usual annealing pots with oxide of iron and the pots mudded up. About one inch of scale is placed between the castings and the sides of the pot and very light sections are placed in the middle of the pots. Seventy-two hours are taken in bringing the ovens up to heat and they are held here for seventy-two hours.

Table II

Calculating Composition of the Charge

Material Pig iron; car No.	Pounds per charge	Silicon Per cent	Silicon Pounds	Manganese Per cent	Manganese Pounds	Phosphorus Per cent	Phosphorus Pounds	Sulphur Per cent	Sulphur Pounds
47210	275	1.45	3.988	0.43	1.183	0.192	0.528	0.034	0.0935
Foundry scrap	150	0.732	1.098	0.243	0.365	0.215	0.323	0.065	0.0098
Steel	75	0.00	0.000	0.500	0.375	0.080	0.060	0.080	0.060
Total, pounds	500		5.086		1.923		0.911		0.1093
Loss by oxidation			1.250		0.300				
			3.736		1.623				
Gain in sulphur from coke									0.132
									0.2413
Resulting analysis		0.747		0.324		0.182		0.048	

The cooling is very important and we have always tried to limit the cooling to six degrees per hour for the first forty-eight hours.

Methods of testing are designed chiefly for the purpose of ascertaining the quality of the castings and are conducted in the shop and in the laboratory. The shop tests are generally for the purpose of determining as far as possible the texture of the iron. Sometimes the castings are supplied with test lugs which are broken off after the anneal to determine whether the castings are fully annealed. Pieces with long thin sections sometimes are bent and twisted to determine the toughness of the metal. Shrinkage in the castings is a serious difficulty and many tests are made for the sole purpose of determining shrink conditions. Shrinkage is often noticeable in breaking off coupons, showing as a spongy mass near the center, particularly where joined to a rather heavy section of the work. The thickness of the white rim is also determined. The skin of the castings is examined for pin holes, and for rounded edges which should be sharp, indicating too high temperature in the anneal.

Melting in the air furnace permits samples to be taken from time to time to ascertain the condition of the iron. A small ladle of iron dipped from the bath is poured into a test plug which is cooled and broken for inspection. Then if the fracture of the test piece indicates the need of it the metal is held in the furnace and not poured until a test piece indicates it is satisfactory. In the cupola the iron must be tapped as melted. If upon tapping the cupola the iron is found too low in temperature, it must be poured into pig bed or into annealing pots. Cupola malleable will not remain fluid as long as gray iron. Also hot iron will chill more readily than dull iron, and as the success depends upon chilling the metal in the mold, it must be poured immediately following the tap.

Test bars are made generally from the fourth or fifth ladle. Three of these bars are made, having good size rises to insure sufficient metal and to avoid as far as possible unsound bars. These bars are packed in the same oven as the castings and annealed. One of the bars is tested for tensile strength and elongation and one for transverse strength. The third bar is reserved for either tensile or transverse tests in case either bar fails to meet requirements.

Test wedges also are made. These wedges like the other test pieces are numbered to correspond with the heat from which they are taken and are packed in the annealing pots with the castings. After the anneal the wedges are broken to determine the quality of the castings.

If metal contains the correct amount of silicon and the anneal has been carried on at the correct temperature the test wedges will show a thin steel white skin, then a dark gray band and a velvety black interior. When the pots become thin, the fracture will show a widening of the white band indicating that more carbon has been removed and finally a slightly burned condition will be shown. As the white band becomes wider, the dark gray band becomes narrower. If the white band becomes ⅛ inch thick the castings will be found to be weak. In a normal casting, the white band is not over 1/64 inch thick.

Castings made from a heat into which a percentage of steel has been introduced will show a fracture, the center of which will approach a gray rather than a black color. Blow holes are generally an indication of low silicon and burned iron. Such iron will be weak and but slightly stronger than gray iron. If the fracture shows distinct flat crystals with smooth shiny faces, the iron was burned in the anneal. Another indication of excessive anneal is the wide white band with a small dark spot in the center.

Each bar is numbered by pressing ordinary steel figures, as used in the machine shop, into the mold before closing. The most satisfactory system of numbering the bars is to stamp the mold with the heat number and date cast. The first part of the heat may be further identified by the letter *A* and the last part by the letter *B* or other distinguishing marks. Where more than one cupola is in use, these may be numbered or given letters which should also appear on the bar.

Shrinkage in cupola malleable is about the same as encountered in the production of furnace malleable. The shrinkage in hard iron is approximately ¼ inch per foot and about ⅛ inch is regained in annealing. The principal trouble encountered with shrinkage in malleable lies in the sponginess it causes in the interior of the castings. This is particularly evident where a light section joines a heavy section. This condition sometimes may be remedied by placing chills around the heavy sections to cause an even cooling in the mold. Cores must be made porous and easily be crushed to avoid setting up stresses in the resulting casting.

The contraction of white iron will vary with the silicon content of the iron, being greater when the silicon is low. Also, if steel is used the contraction will be increased. The percentage of steel that may be safely used in white iron mixtures is somewhat of a disputed point. Some authorities claim troubles in annealing will result if over 10 per cent of steel is used. However, this is not true with cupola malleable. When large quantities of steel are used, troubles are liable to be encountered with excessive brittleness in the hard castings, causing high breakage loss before anneal. Small cracks caused by excessive strains in cooling are apt to occur and get by unnoticed unless detected by the dull flat ring emitted when the casting is suspended and tapped with a piece of metal. For saddlery, pipe fittings and some agricultural castings more than 10 per cent of steel safely may be used.

Besides regular production work, the malleable foundry must supply the annealing pots used in the annealing room and the hard iron stars used in the tumbling barrels. Annealing pots should be cast of iron that will give the best service and longest life under high temperatures. This is of greater importance in connection with the foundry making cupola malleable than with the one using the air furnace due to a temperature of from 200 to 300 degrees Fahr. higher in the anneal in the former case. Generally iron deemed unfit for regular work is used in the annealing pots. A mixture that will give about 0.6 per cent silicon is generally used for these pots. It is not advisable to remelt old annealing pots as they are badly oxidized. The life of the annealing pots ranges from 4 to 20 heats depending on the care exercised in handling them.

A hard iron star mixture that gives good results consists of silicon about 1 per cent, manganese about 0.6 per per cent, sulphur above 0.1 per cent and phosphorus as low as possible. The manganese is run higher to give a harder iron which still is tough. This mixture should contain from 30 to 35 per cent of malleable scrap and about the same amount of gates and sprues, the balance being pig iron somewhat higher in manganese from the regular iron. In case enough manganese cannot be obtained from the pig iron supply sufficient to give the desired analysis, ferromanganese may be added to the charge.

At a recent meeting of the Newark Foundrymen's association, Horace G. Crockett, Scovill, Willington & Co., New York, delivered an address on cost accounting. This meeting was the first of the society this fall.

Heat in Resistance Furnace

The Temperature Gradient Between the Melting and Refining Points and the Heat at the Electrode Can Be Kept Close—Superheating Is Detrimental in Alloy Melting Operation

IN THE center of industrial New York the Bario Metals Corp. recently has completed and placed in operation a new rare alloy melting and refining plant which is unique in many ways. The entire output of the plant is restricted to what may be termed higher temperature metals, some of which necessitate a temperature in the melting zone of from 3600 to 4300 degrees Fahr.

The entire plant includes the departments of management, chemical analysis, melting and machining. All of the operations in the melting and casting plant are with the electric furnace and oven. The equipment includes three Ryan high-temperature melting units, one Northrup high-frequency furnace and one electric core and mold-baking oven.

The Ryan furnace presents new departure in the field of electric metal melting. The units in the Bario plant have a holding capacity of 125 pounds per heat and are capable of melting and refining alloy mixtures in from 30 to 40 minutes from the time the cold charge is placed in the furnace.

The furnace is of the graphite-resistor type; that is, the heat is developed by the passage of current at particular voltages and specific quantities through a stationary graphite electrode. No difficulty has developed in obtaining furnace temperatures up to 4300 degrees Fahr. While temperatures higher than those stated are obtainable in the arc furnace, the difference is that the resistor-type furnace gives a more equal diffusion of the heat over the entire bath, and the temperature gradient between the melting and refining point of the metals, and the heat at the electrode can be kept close, eliminating superheating which is detrimental in alloy melting operation.

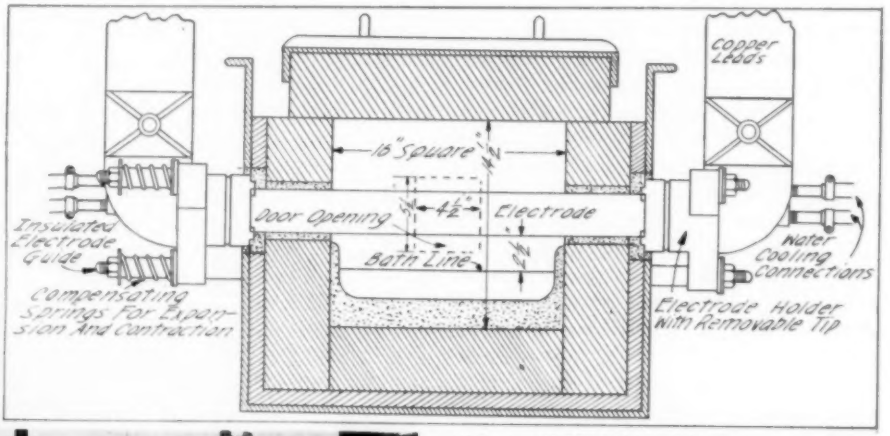


FIG. 2—SECTIONAL DRAWING OF THE RESISTANCE FURNACE SHOWING THE POSITION OF THE ELECTRODE AND THE WATER COOLED ENDS

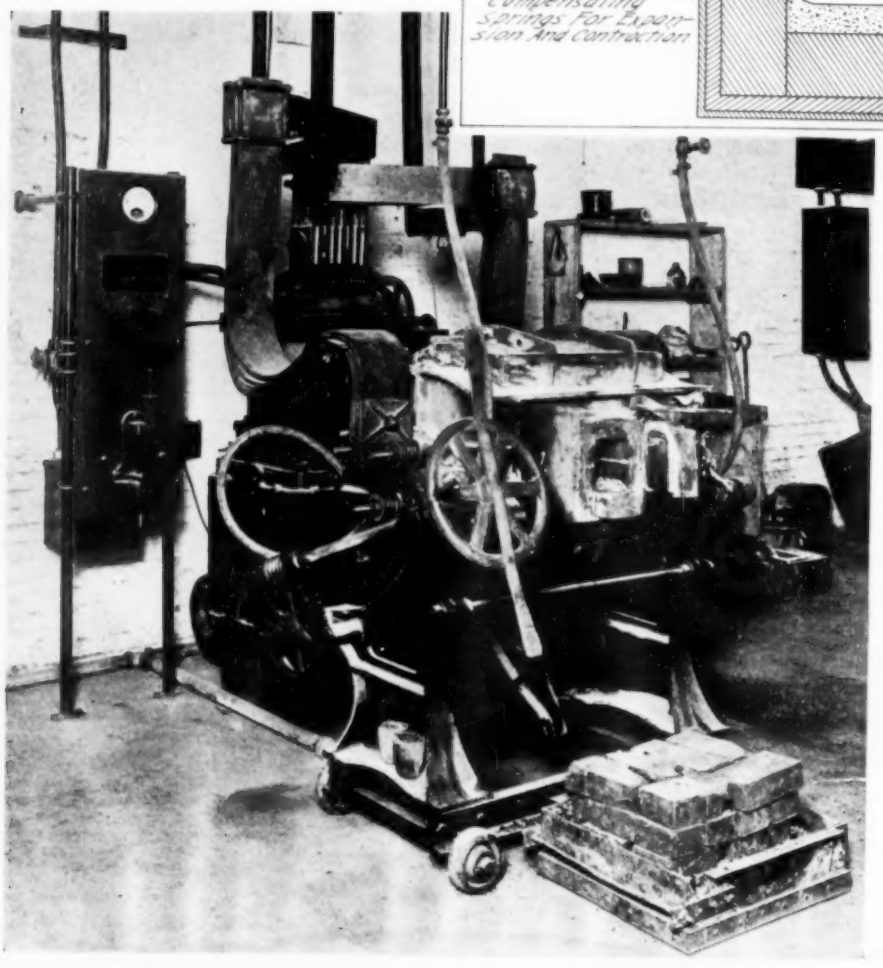


FIG. 1—THE FURNACE BODY MAY BE REMOVED AFTER THE BUSBARS ARE DISCONNECTED

As against this close temperature gradient the heat is developed in the arc melting furnace within small areas at much higher temperatures and even distribution does not take place. This, of course, is not a detrimental factor in the melting of ordinary steel or even commercial alloy steels, but is particularly objectionable in the handling of rare alloys, such as referred to, because of the wide difference in the melting points during melting. F. J. Ryan & Co., who developed the furnace, do not believe that units over 500 pounds holding capacity will become practical owing to the restriction in size and length of electrodes and their placement throughout the furnace. However, in capacities from 50 pounds up to 500 pounds the arrangement and operation is said to be simple and presents no new difficulties over present electric furnace practice.

The arrangement as shown in Fig. 2 is the connection of the furnace unit

through the ends of the electrodes which are in contact with water boxes attached to busbars running back to the transformer set directly behind the furnace, with tap arrangements connected by a radial type switch, which allows a wide range of temperature control. The position of the electrode with relation to the metal is clearly indicated.

The furnace has sufficient door area and clearance to carry on any necessary slagging or charging operations. It is lined with standard magnesite brick both in roof and hearth, and is of the stationary or nose-tilt type allowing for pouring directly from the furnace into molds.

A novel arrangement of the furnace has been worked out to allow for maximum production. With each transformer setting two furnaces have been supplied, each unit being set upon a truck. After the heat has been completed the busbars are disconnected by the loosening of two bolts and the transformer and a new furnace, previously charged, is moved in its place. The entire operation takes place within 5 minutes. This allows for maximum production in relation to horsepower connected load.

It is quite universal practice for power companies to charge for a connected load notwithstanding the percentage of production in relation to the connected load. Therefore, it is of advantage to the customer to be able to work his plant to the maximum point of that connected load. This is not possible where individual units are in operation a specified time and then shut down during pouring periods.

It is claimed by the manufacturers for this furnace that the consumption of electrode and power is not in excess of that which now exists in the best electric melting practice.

Proposes Lines of Foundry Research

BY JOSEPH HORTON

British Correspondent, THE FOUNDRY

PERCY LONGMUIR, D. Met., who has been appointed director of the British Cast Iron Research association, in an address delivered before the Coventry Branch of the Institution of British Foundrymen, said that during the war a vast amount of research was done which greatly advanced their knowledge of foundry practice, though the bulk of it was not for publication. While considerable progress had been made, the speaker indicated several directions in which a great deal of research still is required.

Dr. Longmuir has addressed large bodies of foundry workers in Sheffield and they now have established the Sheffield Foundry Trades Technical society which is to serve the various classes of foundry workers and interest them through papers given on various phases of their daily work. After citing several discoveries in the Sheffield district showing the great antiquity of loam molding, the speaker dealt in detail with several problems which, in his view, were still unsolved.

A problem hotly debated whenever foundrymen meet is that of clearing the mold; whether the mold should be cored out, or whether it should leave its own cores. Refractory materials, including molding sand, call for vast research. In connection with molding sand, the preparation of a mold is not merely a matter of resisting a given temperature; the surging or penetrative action must be considered. If two molds identically prepared and filled, one with molten lead at 400 degrees Cent. and the other with Admiralty gunmetal, the latter will come out, whereas the lead will surge and show a veined appearance, as if overheated or burnt. That shows the necessity for studying the character of different molds.

It is a good general rule to avoid oxidation, and in brass foundry practice all volatilization losses should be made good. This applies chiefly to zinc, in which all loss should be replaced to secure the desired composition. In the same class of work, care should be taken to weigh in the different charges of known materials. Impurities work sad havoc on the final result. Similarly, the scrap should be separated. If that is not done the foundrymen producing carbon steel, manganese, chromium or steel having any other alloy has no chance of success. This is still more necessary in brass foundry work in view of the different melting points as between gunmetal, phosphor bronze and ordinary yellow metal. As a commercial proposition, obviously turnings and borings should be divided into their different qualities. The series of brasses and bronzes based upon the 60-40 copper zinc content require study.

Where ordinary pig iron is converted into steel, oxidation is essential. In a typical charge, blown in a bessemer converter the melter started with 2½ per cent silicon and finished with 0.08. The purification of the pig iron was effected by the oxidation of the blast blown through it, and in some foundry operations oxidation is equally essential, but it is minimized by the cooling action of any manganese silicon or aluminum added, and that branch of metallurgical study would repay the time given to it.

Another side of foundry practice worthy of the keenest study and research is that of the fluidity or running quality of metals, which in the case of alloys is strongly affected by the different melting points ranging from 419 degrees Cent. in lead to 3200 degrees Cent. for tungsten. Liquid shrinkage and contraction present many points for further research, especially in castings having different thickness. Gating often is the cause of warping. Casting temperature is a matter calling for a great deal of careful investigation as tensile and elongation results in regard to all metals often are affected vitally by additional heating for only a couple of minutes. In this connection, the influence of mass and size require careful consideration in the selection of the proper pouring temperatures. For many metals it is the best plan to overheat and then cool down.

Cleveland Headquarters

Roy A. MacDonald, sales manager of the General Refractories Co., is making his headquarters in the Cleveland offices which were established at 1126 Leader-News building. Mr. MacDonald has been with the company since 1910 when he left the Harbison-Walker Refractories Co. after 6 years. Prior to that he had 8 years' experience in blast furnace and steel works construction which followed a course at Pennsylvania State college. At Cleveland he will be assisted by George A. Ferber, formerly with the Pennsylvania Fire Brick Co.

The Gibb Instrument Co., manufacturer of electric welding equipment will remove its plant and offices from Detroit to Bay City, Mich., on Dec. 1.

The Pyrene Mfg. Co., 520 Belmont avenue, Newark, N. J., is enlarging its plant facilities to enable it to do rust proofing work for other manufacturers.

Casting of Aluminum Bronze

Method of Gating Peculiar To This Class of Castings Must Prevent Lathering of Metal—Horn Gates Used with the Large End Toward the Casting —Heavy Risers Needed To Feed Shrinkage

BY CHARLES VICKERS

ALUMINUM bronze has the reputation of being a difficult alloy to shape into castings. When poured into sand molds, especially, it behaves distinctly different to the alloys commonly used in brass foundries. Because of this different behavior, patterns even of simple shape require to be molded in a manner different to, and frequently in a more time consuming way than similar patterns intended to produce castings of the gun metal or red brass series of alloys.

Aluminum bronze drosses and shrinks excessively and when these two peculiarities are successfully catered to, and an apparently perfect casting is obtained, the machinist's tool may uncover gas cavities and internal shrinkage holes, the existence of which was never suspected. And, as if such difficulties were not sufficient, the castings are likely, when machined, to disclose little nests of a white nonmetallic substance (alumina), the presence of which effectively spoils the castings. Besides, in the case of castings massive in size, the alloy changes as it cools slowly in sand molds, and suffers thereby a disappointing drop in tensile strength and particularly in elongation. This change is known as *self annealing*, and with castings heavy of section has to be counteracted either by some device for the quick chilling of the casting, or by the use of special alloys of aluminum bronze, immune to the effects of slow cooling.

A former article dealt with the production of castings of red brass in stick form. Methods of gating and placing the risers there outlined are unsuited for the same castings made of aluminum bronze. As an example of the changed methods necessary with aluminum bronze, the production of a stick of metal, 3 inches in diameter and 12 inches long is taken here as an example.

Risers at Both Ends

In the case of red brass, or any of the so-called gun metal alloys, such a casting could be made successfully by gating and setting risers at one or both ends of same, but such a method in the case of aluminum bronze would not avoid the difficulties caused by its tendency to dross and shrink. When the red brass or gun metal casting shrinks, more or less of a depression will be found on the cope side, and when this is overcome by using a riser of suitable size, the casting will generally pass as sound. No holes will show when it is cut into, but in the case of the aluminum bronze bar, a perfectly cylindrical casting does not always indicate a perfectly sound casting, for when cut into sections a large hole may be found in the center.

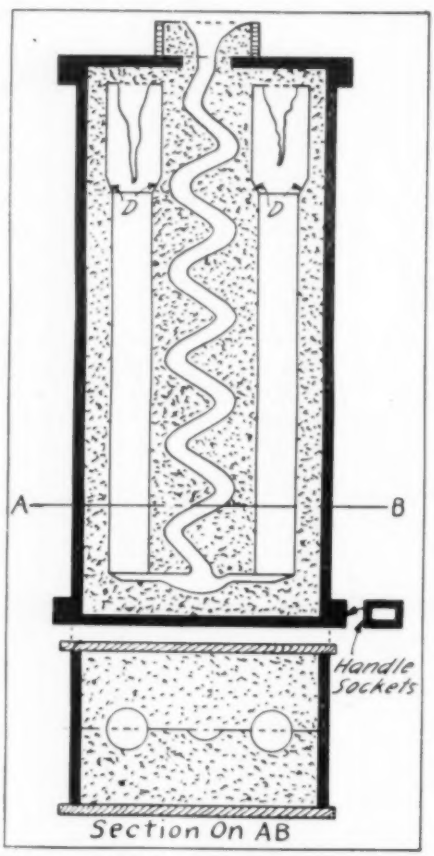


FIG. 1—CASTINGS POURED ON END WITH A SPIRAL DOWN GATE

Such a casting made of aluminum bronze and split longitudinally is shown at *D*, Fig. 2. If the bar had been cast by running the metal in at one end, providing against shrinkage by a suitable riser, also located on the end of the bar, the condition shown in the illustration would likely be encountered. The black outline in the center represents a shrinkage hole in the heart of the casting, more or less circular in cross section and tapering from its middle to either end as shown. Toward each end the hole might be tortuous, being diverted from a straight line by the crystal formation of the metal. Also, its general shape would depend upon the manner of gating and feeding the bar. The shape shown, tapering from the center to either end, is produced when two risers are placed on the casting, one at each end. Each riser will exert a feeding influence for a certain distance along the length of the casting diminishing in effectiveness with the distance, the hole steadily growing larger up to the zone of influence of the other riser. Both risers have the same effect and the result is a long cavity largest at the middle of the casting and dwindling away to either end. Should only one riser at one end be used, the cavity will be club-shaped with the large end away from the riser, provided the mold was poured on a level, but if the mold be inclined from the end at which the riser is placed, the latter being highest, the drossing difficulty will render it imperative to gate in at the opposite end so that the metal will flow gently up hill into the mold, and the result would be similar to a riser on each end, as far as the internal cavity is concerned. While for purposes where the bar is used entire, the cavity in the center might do no harm, and in fact might never be revealed; should the bars be intended for cutting into smaller objects, as is usually the case, it is essential there be no cavity and that the bar be perfectly solid throughout.

One way of overcoming this shrinkage difficulty with aluminum bronze is the method of molding, gating and placing risers as shown in Fig. 1. This method has been used for the commercial production of castings of this shape with gratifying results.

Illustrates Method of Gating

Fig. 2 *A*, shows a section of the mold lengthwise through the riser, gates and runner. *B* is a cross section of the same mold through the riser and gates, and *C* is a plan of the drag half. The riser and gates it may be noted are located midway of the bars, the castings being fed as they shrink from their center toward their ends. As shown at *C*, Fig. 2, two bars of this size can be molded in one flask of standard size and shape. The

cross section of the gates are shown by the dotted circle *E*, in Fig. 2, *A*. The riser itself should be half an inch larger in diameter than the castings, when it has to feed two castings; also it will be advisable to make it several inches higher or longer than the risers for similar castings of red brass. The connection between the riser and the gate in the cope must not form a right angle, but must be rounded off as shown at *F*, Fig. 2 *B*. The object of having the extra metal at this point is to facilitate the feeding of the reserve metal in the riser into the casting, thus filling the shrinkage cavities in the latter.

The above scheme of molding will avoid shrinkage difficulties, both internal and external, but to obtain a maximum output of perfect castings the drossing tendency of the metal also must be taken into consideration. This can be done by following the method of gating shown in Fig. 1. In this example the sprue is located near one end of the flask, for convenience in pouring, and is connected to the base of the riser by a combination of straight runner and horn gate. While the latter is not a necessity in molding such castings, it is sometimes found convenient and is here illustrated to show how it should be used for this alloy. For aluminum bronze the horn gate should be placed just the reverse of the ordinary manner. Usually the small end is placed toward the casting, or in the direction of the flow of the metal; for aluminum bronze, the large end is placed toward the casting and becomes the outflow end. The reason for this change is to avoid the jet or nozzle effect produced by a small outlet tapering from a large inlet. If the passage through which the liquid metal travels, gradually enlarges toward the casting, the force of the stream will be diminished, instead of being increased as is the case with a nozzle. The result will be that the metal reaches the end of its travel, in this case the root of the riser, quietly. When the horn gate is placed the other way about and the metal issues from the small end, it will do so with a spurt like a fountain, and in falling back a ring of dross is created, in the case of aluminum bronze, some of which would be washed into the casting. The correct method of using a horn gate with this alloy is important. Should the horn gate not be used and the runner simply be cut into the riser, it should be given a long slope by cutting it deeper toward the riser root. This would tend to avoid any dropping of the liquid bronze from runner to riser bottom. Any dropping or agitation of this alloy, when liquid, produces the fatal dross. In gating molds for aluminum bronze, it must always be kept in mind that the metal *lathers* like soapy

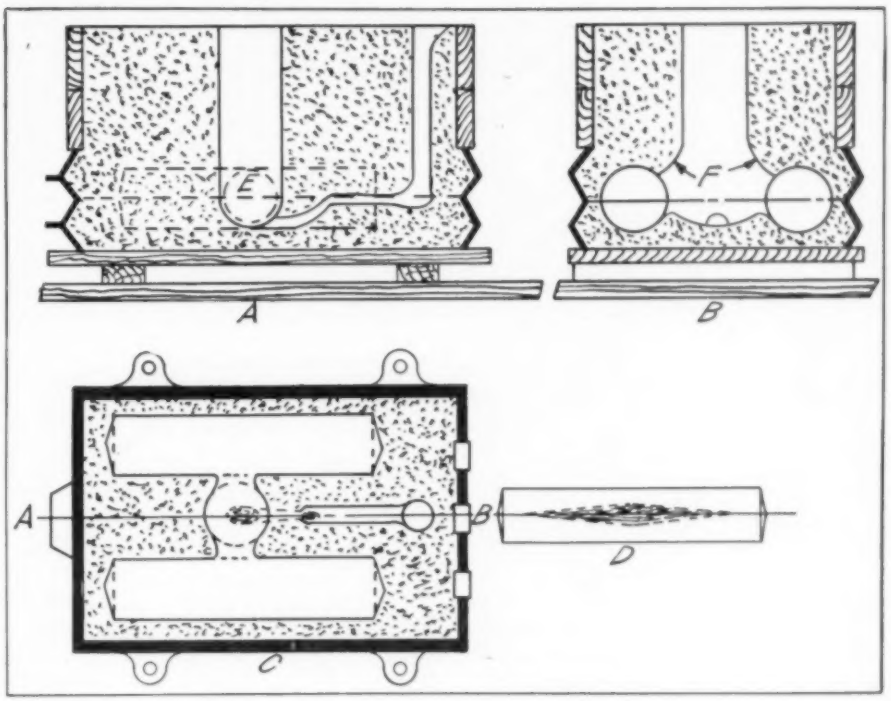


FIG. 2—SECTIONS AND PLAN OF A MOLD SHOWING METHOD OF GATING ALUMINUM BRONZE CASTINGS—AT *D* IS SHOWN A SECTION OF A CASTING CONTAINING A SHRINK FORMED HOLE FROM IMPROPER GATING

water, and this metallic lather, when found in a casting is known as *dross* and sometimes as *smush*. Whatever the name, no casting can be called good that contains it.

Solid cylindrical castings of aluminum bronze are by no means limited to a length of 12 inches; in fact, this particular alloy is more rarely cast into short lengths than are red brass and gun metals. Aluminum bronze is frequently used for large valve stems and for shafting, and a casting three or more inches in diameter and several feet long is not unusual. One brassfounder prefers to cast such lengths on end, and the pattern is made sufficiently long to allow for both casting and feeder, the shrinkage being confined to the upper part which is formed by an extension of the original pattern and is sawed off before the casting is shipped. The mold is made in a two-part flask which has a hole in one end for the passage of the down gate. After the mold is finished and securely clamped it is upended in a casting pit for convenient pouring. As shown in Fig. 1, the downgate is spiralled from the top to the bottom of the mold, and in cross section is a half oval and shallow; in fact it was originally cut in one half of the mold with a gate cutter. After the first casting has been obtained the metal sprue is cut off, trimmed up and used as a pattern in subsequent molds.

Because of its comparatively small section the sprue, or runner, is easily kept filled with bronze while the mold is being poured, and due to its spiral descent, the metal is let down gently and without agitation, and a casting free of dross is the result. The upper end of the casting will, of course, be shrunken and piped, and if it is found that in order to confine the pipe to the sullage part the latter has to be extended to require an unnecessarily long flask, the upper end can be made larger in diameter and be connected to the casting with a taper as shown at *D*, Fig. 1.

This spiral runner of small cross

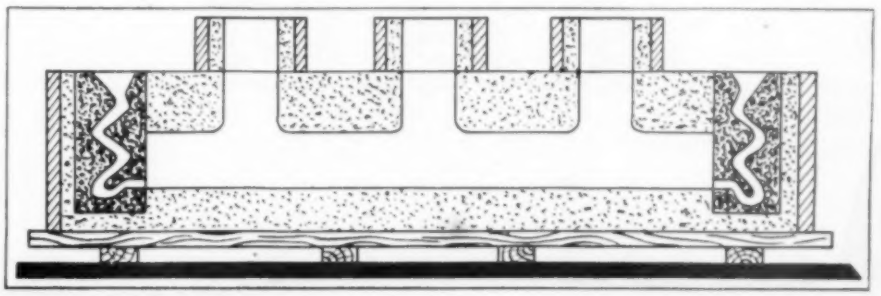


FIG. 3—CASTING POURED FROM BOTH ENDS WITH SPIRAL DOWN GATES AND HAVING THREE RISERS BUSHED ABOVE THE TOP OF THE COPE

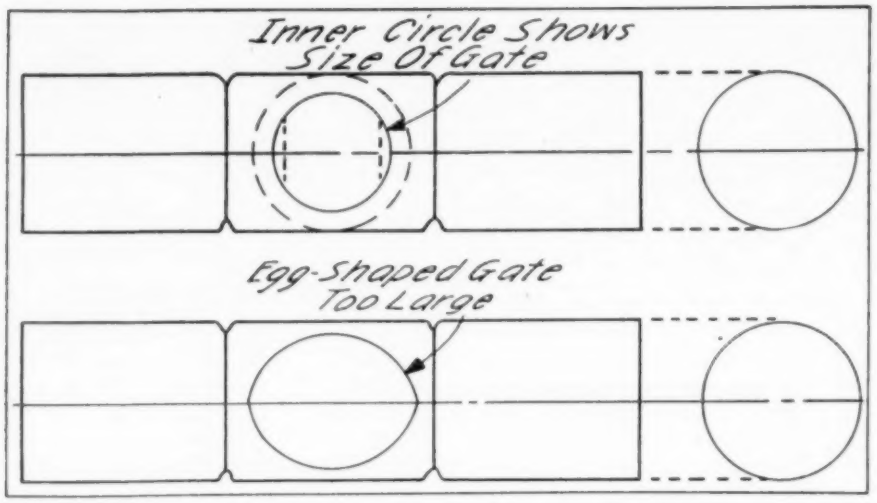


FIG. 4—METHOD OF MAKING THREE SHORT CYLINDRICAL CASTINGS IN ONE PIECE TO BE CUT APART—NOTE THE RIGHT AND WRONG METHOD OF GATING

section is an important means of securing dross-free castings of aluminum bronze because it eliminates vertical sprues of large size, down which it is impossible to drop liquid aluminum bronze and not create an excessive amount of lather, or dross. When a shaft or stem of large diameter has to be cast, the horizontal mold frequently is found to be the best. When a casting six or more inches in diameter and several feet long must be made, and a straight cylindrical sprue is used, such a large amount of dross will form as a result of the agitation produced by the drop of the metal that it will be difficult to keep it out of the casting. Fig. 3 shows how the spiral sprue can be used. It is applied through the medium of a core which is rammed in the cope and connects with a second core in the drag which conveys the bronze to the lowest part of the casting and thus produces a smooth flow of metal, without agitation, and without dross.

Runner cores for aluminum-bronze castings should always be bonded with silicate of soda and water as this binder will not burn out as the hot metal courses through, and it will not give off gases that might cause agitation of the metal with the production of dross.

Owing to the heavy pipe of aluminum bronze it is advisable to bush the risers up higher than the top of the cope in the case of a heavy casting as shown in Fig. 3. If the risers were simply carried as far upward as the top of the mold the pipe which forms might extend into the castings. To avoid this difficulty a dry-sand head should be placed over each riser about 6 inches high in the case of a mold having a 10-inch cope. When the mold is poured it is filled with liquid metal to the top of the down gates, the latter are covered with molding sand, and a weight is bedded on them, after which the risers are filled with fresh hot metal. The casting in this case is poured from both ends, but both ladles are not always poured at the same time. One successful maker of such castings would commence pouring at one end with a ladle large enough to fill the mold to about 2 inches above the bottoms of the risers, then would slowly pour from the opposite end with a smaller ladle of metal, slightly hotter than the first ladle, until the mold was filled to the top of the sprues, which were then weighed and the pouring finished by filling up the risers.

By waiting a little time before pouring into the risers, it was thought the outer layers of metal would begin to solidify, and the metal poured into the riser would force its way through the heart of the casting and so fill any pipe that might form. It was found that when the metal poured into one riser brought the other risers up to its level the soundest castings were obtained.

Fig. 4 shows a short cylindrical casting, about 3 inches diameter and 4 inches high, numbers of which have been made of aluminum bronze. While they appear simple to make, and would be when made with other alloy, they often cause a lot of trouble in aluminum bronze owing to the difficulty of controlling the shrinkage. A good way to avoid loss is to make them in a long bar as illustrated in Fig. 2. Slight grooves can be made in the pattern, as shown in Fig. 4, to indicate where to cut them.

The term aluminum bronze can be taken as meaning any alloy of copper and aluminum, with or without additions of other elements, which have a base of copper. An alloy commonly used for small castings is copper, 89 per cent; aluminum, 10 per cent, and iron, 1 per cent. This has some advantages over the alloy of 90 per cent copper and 10 per cent aluminum. Where great strength is required, as in the case of large valve stems, shafting, etc., an alloy of copper, 86 per cent; aluminum, 10 per cent; iron, 4 per cent is extensively used. Since this alloy was devised by the author in 1916, it has been extensively used under a variety of names, a proof of its remarkable qualities. In 1918, patent No. 1,264,459 was granted from application filed Sept. 27, 1916. Its physical properties will vary according to the skill with which it is made. In tensile strength the cast metal should reach considerably over 80,000 pounds per square inch and its elongation should not be under 17 per cent, sometimes running as high as 30 per cent.

How and Why in Brass Founding

By Charles Vickers

Copper Castings for Blast Furnace Tuyeres

Would you please furnish us a formula for an alloy suitable for making tuyeres for blast furnaces? Also we desire a formula for an acid-resisting bronze, to be used in about a 5 per cent sulphuric acid solution. As we have received formulas from you in the past and have found them to be satisfactory, we have come to the conclusion there is no use in our doing experimenting.

Blast furnace tuyeres are made of copper and the less alloy the copper contains the higher will be its melting point. Because of this fact it happens frequently that quite a pure grade of copper is specified. The copper is specified. The copper is melted under charcoal in the case of crucible melting and a few minutes before pouring time about 1 per cent of silicon copper containing 10 per cent of silicon is added and the bath

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note book form.

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 454)

When using the higher magnifications a finer powder is needed. Twelve hour, No. 3, alumina is probably best for such work. Rouge gets into cracks and sometimes discolors the sample.

Broadcloth is the best backing for polishing powders, while canvas is used for emery flour. When fine abrasives are mixed with water the mixture must be thin enough to flow freely. The mixture should never be thick and pasty. As water has so little body the addition of a little gum, glycerine or similar substance will increase its viscosity and make it *hold* better to the cloth. In some cases it may prove advisable to suspend the powder in a light oil. When this is done the oil must be thoroughly removed, or etching agents will not act. The polishing liquid can be kept in a bottle, arranged to agitate the liquid with a current of air and to have it drop continuously during polishing; or the mixture can be agitated and fed by hand. It is important to keep the polishing cloth free from grit. The sample should be cleaned thoroughly before placing it on a finer abrasive; the cloths should be protected from grit and dust; the dry abrasive must be first class and kept clean; the water must be clear, and air used for agitation should be washed. If grit gets into the polishing materials they should be thrown out, as it will be impossible to do good work with them.

Polishing should be continued just long enough to remove scratches. Long continued polishing will produce relief effects and may destroy the flatness of the specimen face. This will make it much more difficult to get a flat field at high magnifications. Uniformly hard materials are easiest to prepare. Gray iron is very nonuniform. While the average specimen is moderately hard, some irons are soft and spongy and others are extremely hard. In the same piece steadite is very hard while graphite is soft. Low carbon steel and wrought iron are soft and ductile. Scratches are hard to remove and subsequent etching does not cause them to disappear. Brass and bronze are fairly soft but when etched do not often show scratches. Lead and babbitt metals are so soft that it is extremely difficult to polish them satisfactorily. High carbon and high speed steels give little trouble.

(*Continued on Data Sheet No.* 456)

MICROSCOPY OF CAST IRON

(*Continued from Data Sheet No.* 455)

Etching—A number of etching reagents are listed in the Data Sheets, Nos. 335 to 338, June 1 and 15, 1920.

Picric acid is the best all around reagent for gray iron and steel. The solution used by the author contains approximately 78 per cent of a saturated alcoholic solution of picric acid, 20 per cent of water and 2 per cent concentrated nitric acid. This solution acts uniformly, is rapid, and brings out the structure of pearlite, ferrite, and steadite clearly. The face of the sample is immersed in a small amount of solution in a watch glass. As is necessary when using any etching reagent, the sample is kept in motion to dislodge any air bubbles and insure even etching. On some samples 4 or 5 seconds is sufficient time to bring out the structure for examination at high magnifications. More etching tends to produce more contrast at lower magnifications. All etching is cut-and-try work, and no exact rules as to time, etc., hold. Experience and actual microscopic examination are the proper guides. After etching the sample should be rinsed in water, then in alcohol and dried, preferably by warm air blast, although soft toweling may be used.

Picric acid develops the laminar structure of pearlite. Due to a slight relief effect the ferrite laminae appear dark and the cementite white. At low magnifications the whole pearlitic mass appears dark gray. Picric acid brings out the cellular structure of staedite, and does not attack its phosphorus-rich matrix. The etching tends to be a little uneven. At low magnifications steadite dendrites generally appear white and structureless. Picric acid solution made as directed here is satisfactory for bringing out the polygonal grain structure of ferrite. The graphite of gray iron has some tendency to absorb picric acid, and other reagents, during etching and unless care is taken in cleaning the reagent oozing out of the graphite may discolor the face of the finished specimen. Picric acid is not satisfactory for bringing out the structure of hardened steel.

(*Continued on Data Sheet No.* 457)

thoroughly stirred. Sometimes phosphor copper is used in the proportion of 6 ounces of phosphor copper to 100 pounds of copper, also various proprietary deoxidizing agents are used.

If the 5 per cent solution of sulphuric acid is used hot, it will attack any ordinary bronze, no matter what its formula may be, and if used cold, in time it will attack any bronze or brass, although manganese bronze will resist it as well as any copper alloy. If a red metal is desired use the following alloy: Copper, 89 per cent; tin, 6.50 per cent; zinc, 2 per cent; lead, 1.50 per cent, and nickel, 1 per cent. Add the nickel in the form of a re-made alloy of nickel. Alloys having a base of nickel will resist sulphuric acid, both hot and cold much better than the strictly copper alloys, but are of no value for hydrochloric acid solutions of any strength, as even a solution as weak as 10 cc hydrochloric acid to 90 cc water will attack them strongly. Such an alloy is: Copper, 59 per cent; nickel, 23 per cent; iron, 1.0 per cent; zinc, 15 per cent; silicon copper, 2 per cent.

How to Feed Test Pieces

We are making small valve stems of an alloy that might be termed manganese bronze, the composition being, copper, 60 per cent; zinc, 40 per cent; iron, 1 per cent; manganese, 0.5 per cent; aluminum, 0.75 per cent; lead, 2 per cent. Tests are taken from the stem which has a core of yellow metal, that so weakens the castings that they fail to meet the requirements of 55,000 pounds per square inch tensile strength, and 15 per cent elongation. Can you tell us what causes this defective area of metal? The stem is molded in green sand on a machine, eight castings in a mold, and cast horizontal. The riser is placed on the end of the stem, and the metal is poured at from 1700 to 1800 degrees Fahr.

The lemon colored area is not sound metal; under the microscope it will be found to be full of voids. The missing part of the alloy is the eutectic which has drained to some other part of the casting. The situation is similar to that prevailing when manganese bronze test bars are made from cast-to-size bars. It is necessary to put a longitudinal feeder in the cope and connect the test bar with it by a continuous gate as shown in the article on this subject in THE FOUNDRY, August, 1917, where the method of making the feeder is illustrated.

These castings will have to be fed sound to meet the specifications for tensile strength. For feeding purposes on bronze, a blind riser, one that does not cut through the cope, always is more effective than one that cuts through. In this case if a riser shaped like a heavy runner could be laid between two castings it would feed both. One 3 inches long would feed the stem where it is smallest; it should parallel the same, and the gate should be continuous the length of the riser, about 3 inches in this case. The opening into the casting should be 3/16 inch, and the gate should thicken sharply toward the riser itself. The end riser will only feed a short distance. By nicking and breaking a casting this can be noted.

Character of Alloys Is Shown By Analysis

We are melting brass sheets in crucibles and running the metal into 22-pound ingots. We make builders' hardware and should like to make two alloys from these ingots, one soft and the other hard, but both yellow when polished. Also, we should like to learn if a small amount of aluminum in the alloy will make it run any better.

An analysis should be made before attempting to change one alloy into another. Then the composition of the alloy to be changed will be known instead of guessed. Guesses seldom are reliable. In any case the composition of the scrap will not be the same after it has been melted and run into ingots. Some of the zinc will have burned out. Drillings from the ingots will be required to determine the analysis and to obtain these samples it will be advisable to consult the chemist who is going to make the analysis.

Composition of a soft alloy will approximate: Copper 77 per cent, zinc 20 per cent, tin 1 per cent, lead 2 per cent. Assuming the composition of the sheet brass as copper 70 per cent, zinc 30 per cent, then to make a soft brass it will be necessary to melt together 67 pounds brass ingot, 29 pounds copper and then add 1 pound tin and 2 pounds lead. It is neither advisable nor necessary to add aluminum to the foregoing alloy. The hardness can be increased to any extent by increasing the tin content at the expense of the copper. If a cheap, hard alloy including aluminum is desired it can be made by adding 17 pounds of zinc and from 1 to 2 ounces of aluminum to 100 pounds of the 70-30 ingot. To compensate for the loss of zinc incurred in melting the sheet brass it will be necessary to add new zinc in the proportion of 1 pound to 17 until the ratio of 70-30 has been attained.

Nickel Silver Melts at High Temperature

Please advise the proper temperature at which to melt nickel silver of the following formula; Copper 65 per cent; nickel 20 per cent; zinc 15 per cent. We have experienced a little difficulty with spongy castings from this formula. We have melted the other ingredients and when molten have added the nickel in shot form. Would you deem it advisable to first ingot the alloy and remelt for castings.

The melting point of the alloy will be around 2500 degrees Fahr., and it will have to be superheated for pouring. If the furnace easily attains this temperature, there is nothing wrong with it, but if the temperature is attained with difficulty and the alloy has to remain under fire for an unnecessary length of time, as compared with bronze, then the furnace should be replaced by one using oil or gas, that will melt the alloy easily.

Better results will be obtained by using an alloy of half copper, half nickel to carry the nickel content. This alloy should be melted with the copper under charcoal, mixed with a small amount of borax. When the alloy is thoroughly liquid, add manganese copper, in the proportion of 4 ounces to the 100 pounds followed by the zinc content, or some other good deoxidizer which may be noted in the advertising columns of THE FOUNDRY.

Should shot nickel be preferred, melt the nickel and the copper together, add the deoxidizer and then the zinc, and pour the metal into ingots which later may be remelted for the castings.

Equipment for Treating Furnace Residue

We desire information on the subject of equipment for treating copper and brass residues and drosses. Also what kind of furnace is best adapted for melting brass, bronze and aluminum turnings?

If the residues are in the form of brass furnace ashes, skimmings and sweepings the first operation is to remove any large pieces of metal, the second to pulverize the ashes and clinkers, and the third to concentrate the fine residue. To accomplish all these it will be necessary to install an equipment of jigs, ball-mills, and concentrating tables. A description of methods for reclaiming brass residues with illustrations of the equipment necessary will be found in the May 1915 issue of THE FOUNDRY, page 191-192.

Both crucible and noncrucible containing furnaces are used successfully in melting brass turnings, and it is a question if it would be possible to state which is best. All depends upon the individual preferences of the user, and one reason so many different types of furnaces are manufactured, is to afford the purchaser a wide range of choice. The tilting iron pot furnace appears to be well adapted to melting aluminum turnings and is greatly favored in America.

Designs New Electric Furnace

Metal Melted in Crucible Shaped Vessel with Only One Opening—Electrode Through Roof Sheathed To Prevent Ingress of Air—Other Electrodes Placed in Lateral Lining in the Hearth

BY R. SYLVANY

THE greatly increased application of electrometallurgy has directed fresh attention to the different types of electric furnaces capable of being successfully employed for melting and refining metals. Many types of furnaces have already been adopted in industrial practice and have been widely installed.

The furnace described in this paper, the idea of which is due to T. Levoz, a French metallurgist, presents certain interesting features, and illustrates one of the latest French developments in this field. The use made of it during the war for the production of high-speed steel demonstrated the principles on which it is constructed and which we shall briefly describe.

The refining of a steel bath is effected by the action of the slag, of a fixed composition, on the molten metal. This action is made up of several reactions which require for their realization certain conditions already laid down by Prof. Campbell in the course of a meeting of the British Iron and Steel institute, when the first practical trials of electric furnaces were being made.

The slag must be brought to a high temperature, as this temperature and the resulting fluidity combine in facilitating the refining reactions. The rapidity of these reactions, indeed, increases with the temperature, the increase being much more than proportional.

Furnace Kept Closed

The great fluidity maintained in a basic slag and the formation of calcium carbide by the action of the arc upon the limestone slag are two conditions which favor desulphurization.

The thorough rabbling of the bath is indispensible, as it is necessary that every part of it in succession shall be brought in contact with the slag so that it may free the metal of its impurities. This rabbling must be secured by a suitable distribution of the current.

For this reason Prof. Campbell laid stress upon the following important points, the realization of which appeared to him essential:

The furnace should be closed as much as possible and should be of the simplest possible construction; the furnace should be entirely separated from the electrical fittings of the generators and transformers, which should be maintained at their highest capacity in order to increase the power of the installation; the wear of the refractory materials of the linings should be saved by applying the heat at the center of the bath, and those of the roof by protecting them from the direct radiation of the arc by the electrodes themselves; the slag should be given as large an area as possible so as to increase the refining surface; and the temperature of the slag should be maintained above that of the steel, so as to secure fluidity and facilitate the high basicity required by an intensive refining process.

Prof. Campbell also advised the use of a homogeneous and solid hearth, and with this in view, recommended that electrodes should not be allowed to pass through it. On the other hand, Dr. W. Borchers, who was one of the pioneers of electrometallurgy, was speaking of the satisfactory results obtained by this latter type of furnace. The principle of this, the Girod furnace, was based on a combination of the resistance arc furnace. The metal to be melted constituted one of the electrodes, the slag covering it forming an electrolytic conductor, the metal constituting the resistance, and the current being distributed by one or several carbon electrodes traversing the roof and by multiple contacts passing through the bottom. There was no question of the solidity of this furnace. The advantages arising from a uniform distribution of the current, effected by the arrangement of the contacts passing through the bottom, constituted one of its essential characteristics, namely that of insuring the efficacy of the furnace's refining action.

The section and length of these contacts were such that no one of them could carry more than a certain fraction of the total current without becoming overheated and, consequently, without its resistance being excessively incerased. The regulation of the temperature and resistance of each contact was effected by cooling the hollow extremities by a water circulation system. Certain inconveniences were thus remedied, and as a result of the uniform arrangement of the contacts around the prolonged axis of the carbon electrodes the advantage of a uniform rabbling of the bath was obtained. Prof. Campbell's one objection thus disappeared; moreover, the results already obtained at that time demonstrated the furnace's merits.

Life of Lining

When regularly working, the lining, which was chiefly composed of burned dolomite, withstood at least 80 heats. The bottom of the furnace stood 120 to 160 heats without repair and had then lost 4 inches in thickness. With charges of molten metal the lining could stand 200 operations, and the roof about 20 to 35. The wear of the other parts of the furnace was comparatively slight and the consumption of carbon electrodes was from 26 to 33 pounds per ton of steel.

The principle adopted in the Girod-type furnace, which was also to be adopted in the Keller-type furnace with a better distribution of current, thus marked an advance in the construction of electric furnaces.

In the Keller-type furnace the distribution of the current in the bath, instead of being merely carried round a certain number of contacts, was effected over the whole depth of the bath by means of a bundle of iron bars surrounded by refractory clay which formed the furnace bottom. The current was introduced by a large carbon electrode rectangular in section.

As in the Girod-type furnace, the intensity of current necessary was high, as it had to reach 3000 amperes; but this high intensity had fewer disadvantages as the current was better distributed and the electric resistance in the large single electrode and in the conducting hearth was not as great. The difficulty of water cooling and of

Paper prepared for the recent convention of the American Foundrymen's association held in Rochester, N. Y.

overheating of the carbon electrodes was avoided.

The principles laid down by Prof. Campbell therefore were observed in this furnace, notwithstanding the fact that the conductors passed through the hearth.

On the other hand, it might be objected that they were not followed in the first furnaces of the Heroult type, in which the better basic action was counteracted by the imperfect closing of the furnace, which was opened by three lateral doors and had the two electrodes passing through it from the roof. Nevertheless the effectiveness of the furnace was not as great as it might have been, although the rectangular surface of the bath was extended, because of the action of the arc being concentrated only in the vicinity of the electrodes. The intensity of the current alone was greatly reduced. The rectangular section, therefore, was unsuitable and at Remscheid it was reduced only to the zone of action of the arcs. The circular form introduced by Nathusius seems to be preferred, and it was this form of section which Heroult adopted for the 15-ton furnace which he built in the United States.

All these considerations led the inventor previously mentioned to produce a special type of electrical furnace, in which the principles already indicated were further developed and the various defects were minimized.

He sought on the one hand, to secure rapidity of fusion and on the other to insure good purification by making the current pass as directly as possible—but at the same time with uniformity of distribution—through the metallic mass and the slag, the furnace being simple in construction, strong and well closed, without an excessive intensity of current being necessary.

New Type of Furnace

For this purpose he constructed a crucible with only one opening for charging the material and the additions and for pouring the finished metal. He also placed the large carbon electrode in a sheath to obviate air currents in the space left free between the electrode and the roof. Thus he facilitated a better basic action.

Moreover, certain trials made for the first time at the electric power station of the commune of Jambes in Belgium enabled him to discover the possibility of placing electrodes in the lateral linings of the crucible without their being affected by wear at that level.

In fact, as the lateral linings of the furnace presented a larger surface than that of the hearth (bottom) the number of iron conductor bars embedded in the linings can be increased so that their section can be lessened.

Thus a strong magnesite bottom can be composed which resists the action of overheated metal much better than an armored hearth.

Wires of 0.25 to 0.4 inches were found sufficient to obtain currents of 1200 to 1500 amperes at 85 volts capable of developing the temperatures necessary for the purification of the entire mass notwithstanding the depth of the bath.

Metal Conditions

The electric resistance of the conductor electrodes thus constituted is almost negligible, for, as has already been pointed out, the surface of the linings permits bringing into play a considerable number of wires equivalent to such a large conductance section that, without taking account of the conductivity of the bottom the loss is already practically nil.

The use of metal conductors of small section tends to produce a more uniform circulation of the electric current than the use of conductors of large section and the large surface of the positive carbon electrode is well utilized owing to the excessive splitting up of the current at the surface of the bath.

The slag is highly and uniformly heated throughout its surface, and its temperature may be raised to the point required to secure good fluidity and intense chemical action.

To facilitate the process of refining still further the inventor was led to adopt a special device which consists in introducing two rows of superimposed lateral electrodes, the lower ones being termed fusion electrodes and the upper ones refining electrodes.

The fusion electrodes, which vary in number with the capacity of the furnace, are formed by a bundle of pure iron wires imbedded at the base in a mixture of magnesia and tar and united at the top so as to give a good contact with the metal contained in the crosswise channels arranged in the furnace hearth.

These electrodes are joined in series by a copper bar, which is itself connected by cables to the negative pole of the current transformer. The refining electrodes, which are placed on a level above that of the others, facing the slag, are also variable in number according to the capacity of the furnace.

A special device enables the current to be taken from the fusion electrodes and afterward from the refining electrodes, or alternatively from both rows of electrodes at once.

The number of wires forming the electrodes, as also the section of these wires, varies with the capacity of the furnace. The wires of the fusion electrodes have always a larger section than those of the refining electrodes.

In every case the current enters by a large vertical carbon electrode passing through the furnace roof, its horizontal section being half that of the furnace crucible.

When direct current is employed this large positive electrode is hollowed out and forms a heat reflector; moreover the oxygen of the bath is liberated and is carried to the positive pole instead of remaining in the bath and oxidizing it.

The furnace proper consists of a steel plate body with a nonconducting refractory lining and fitted with a cover. Hollow trunnions, through which the conductor cables pass, enable the whole apparatus to be tilted.

In this furnace the current always passes through a layer of relatively thin metal, which enables currents of much low intensity to be used. An intensity of 1500 amperes is not exceeded; nevertheless the temperatures obtained are diffused throughout the entire mass of the slag and metal.

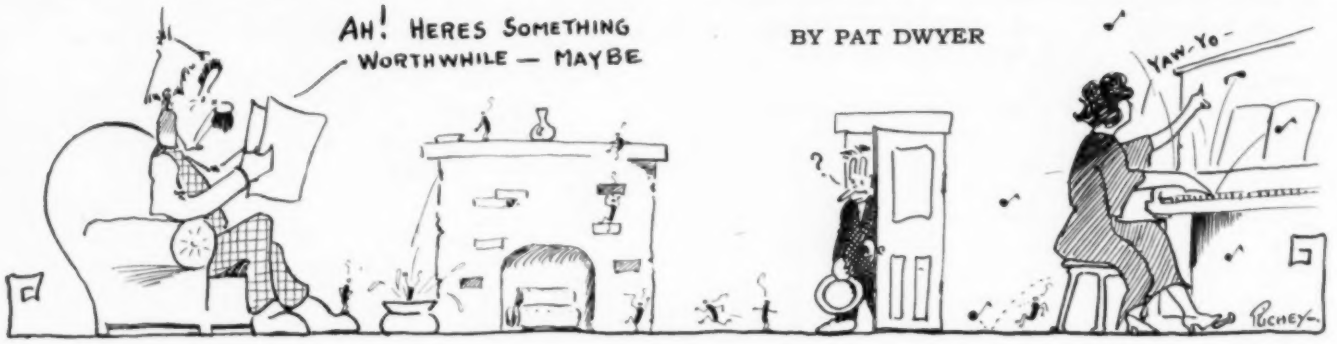
As was mentioned at the beginning of this paper, this furnace was employed during the war in the production of high-speed steel. It was installed at the Jarville works of the Eclairage Electrique Co., near Nancy, now amalgamated with the Thomson-Houston Co. The results obtained appear to indicate that, with continuous working and by treating 2200 pounds per heat with an amperage of 3000 at 80 volts it would be possible with one furnace to obtain an output of 8 tons per day by deoxidizing the metal obtained from a converter.

British Institute Holds Special Election

At a special general meeting of the Institution of British Foundrymen held at the College of Technology, Birmingham, Oct. 7, Oliver Stubbs was elected senior vice president with a view to his assuming, for the second time, the position of president next year. The vacancy was created through the inability of H. T. Jewson, of East Dereham, to accept the position. It was decided to hold next year's conference in Manchester in midsummer.

The total value of brass, bronze, copper and other nonferrous castings and machinery fittings manufactured in 1919 was $131,022,462, according to the census of the department of commerce.

Bill Receives a Remarkable Document



IN A recent edition of a certain national Saturday weekly, that always appears on Thursday, I read an article purporting to describe conditions as they are at present and have been for some time in the land where the river Shannon flows. I started to read it under the impression that here was something worth while, inside stuff, fresh and uncensored and probably written by a Shannonite, a native of the country with a knowledge of its inhabitants, their habits and customs, peculiarities, trend of thought and other features. I began to lose interest when I learned that the author left London on the evening train and arrived at Holyhead in time to catch the 2 a. m. boat that carries the mails to Dublin.

In the first place, I reflected that a man whose habitat is London is scarcely the type to invite or receive the confidence of the people among whom he proposes spending a few days with a view of finding out definitely just what is what, who is who and why. In the second place, and this is fairly obvious to any person who has had a similar experience, a man who has to change from a train at 2 o'clock in the morning, grope his way along a fog enshrouded dock and up a slippery gang plank, and disembark three hours later after a sea sick trip of 60 miles; disembark mind you and go look for a breakfast before the city is awake, such a man, I maintain is hopelessly prejudiced before he begins to make any confidential investigation. An empty stomach, especially one that has been emptied involuntarily and under protest, will color the judgment and sour the opinion of any man of less poise and patience than an archbishop.

Having set my hand to the plow, in a manner of speaking, I plowed through the entire article from beginning to end, but failed to find anything that I had not already seen touched upon in regular newspaper dispatches on this side of the Atlantic. In fact, I might go further and claim that I had seen many wonderful newspaper stories which the writer in question apparently had overlooked in his hurried jaunt over the zone of warfare.

I was not surprised at that. Indeed no person reasonably could expect that one man could cover the ground as completely as a myriad of special correspondents working on a space rate basis. However, I was surprised that he should have gone to the trouble, expense, mental and bodily anguish involved in faring forth into a strange land when he could have remained comfortably at home and with a shears and paste pot evolved just as illuminating a story from a file of daily newspapers extending, at the outside, over a period of a few months. Shortly after I had read the article and while the paper still lay open in my hands, Bill came in and added his comment.

"Of course it's mostly piffle," he said, "and adds nothing to the sum total of our knowledge concerning the most distressful country that ever yet was seen, etc.; but there is one point mentioned which presents a curious co-incidence. The statement is made that while the party of the first part were besieging the party of the second part, strongly intrenched in the historic Four Courts, Dublin, an explosion took place that blew up a room containing priceless treasures, namely ancient documents.

"The papers, some in fragments and others practically intact, were scattered over a wide area. They were blown here and there by the wind, picked up by pedestrians, glanced at carelessly in the majority of cases, carried a long or short distance depending on the interest of the reader and then thrown away. Jim Skelly picked one up in Phoenix park and was astonished to find that it contained an elaborate account of all the circumstances surrounding the casting of the golden calf. So far as I know the only version published hitherto is that contained in Exodus XXXII and you know that account furnishes none of the technical details.

"I don't think you know Jim. I worked with him many years ago in the Hecla in Brooklyn and we have kept up an intermittent correspondence ever since. He is a native of the old sod and was educated for the church, but he had a streak of wildness in him and ran away to America before he graduated. The fact that his father conducted a foundry in Limerick may have influenced him in his choice of a means of livelihood. At any rate his father died eventually and Jim went back to his native land and carried on the business.

"He does not state what he was doing in Dublin on the day he picked up the paper. In a letter which I received this morning he merely refers to the fact that he found it while crossing Phoenix park and then goes on to say that while it was written in Latin he experienced no particular trouble, thanks to the years he spent in college, in making a fair and readable translation.

THE DOUBTING THOMAS STILL IS WITH US

"At first he felt inclined to incorporate the material in a paper to be presented at a meeting of one of the many foundrymen's associations, but when he reflected on the volume of correspondence that course would entail before and after reading the paper, he decided that he was not equal to it. Further, he felt reasonably certain that a number of doubting Thomases, who seem to infest every organization, would take the keenest delight in examining the story microscopically with a view to finding a peg on which to hang an argument. While he felt perfectly willing to submit the story as a contribution to the general store of foundry history, knowledge and tradition, he had neither the time, the inclination nor the temperament required to defend it from the attacks of captious critics.

"He admitted that he had derived considerable pleasure from the task of translating the manuscript and paid a scholar's meed of praise to the dead and forgotten scribe who had made the Latin copy from the original Hebrew. Outside of a few technical terms, which naturally had changed somewhat in the course of approximately 5000 years he had experienced no trouble in following the copy and the modern equivalents of the unfamiliar technical terms readily had suggested themselves from the context. He intended to keep the original and the translation, and, thinking that I might be interested, he kindly had enclosed a copy for my edification. He had made no attempt to follow the style of many translators who seem to labor under the impression that unless they retain the archaic forms and sentence construction peculiar to the language from which the translation is made, their work will not have the proper flavor.

"They go further, and this is a point on which I think a committee of five should be appointed with full power to act—with a Gatling gun preferably, but if the neighbors object to the noise, a meat axe will serve as a satisfactory substitute. Yes sir, I am talking now of those birds who leave as many undigested foreign words in the translation as there are knots in a crooked spruce log. The reader skims along peacefully for the better part of a paragraph and then bumps against one of those things and enjoys practically the same sensation as is experienced by the man sawing a board who bumps into a knot or a rusty spike."

Jim's translation was free in the sense that it followed the spirit rather than the form of the original, but I have no reason to doubt its accuracy, even though I was surprised to note how closely the foundry practice of the ancients paralleled that of the present day. Bill was good enough to allow me to copy the manuscript after I had read it and therefore I can present an absolutely perfect reproduction, instead of depending on a memory which occasionally plays tricks on me.

The size of the written or printed characters was not indicated, but apparently the original article appeared in a newspaper of some kind under the familiar style of head and two or three line deck.

DEDICATED TO TEACHERS AND PUBLIC SPEAKERS

TURNS OUT LITTLE BULL IN RECORD TIME

Beautiful Figure Emblematic of Community Spirit Recently Completed at Local Plant

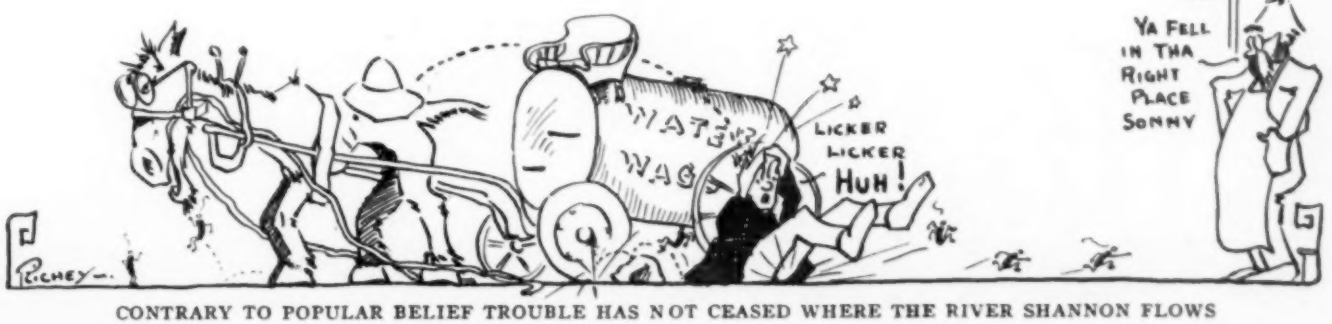
Yesterday afternoon at 3:30 (daylight saving time) in the presence of a large and distinguished company, John T. Handspike, foreman molder at the plant of the Mt. Sinai Ornamental Metal Works, (S. Levi, prop.) pulled his mezzanine type Derby a trifle further down over his ears and motioned to his men to pour the full pots of metal into a prepared mold. At 4:30 the greater part of the covering had been removed and the visitors had their first glimpse of the metal figure the conception and execution of which have furnished an endless theme for discussion in private and public ever since it first was suggested by Mayor Aarons on his return from his latest annual Winter trip down the Nile.

The chief magistrate introduced the subject during a lull in the council meeting preceding the Passover, declaring it was a shame that a hustling, progressive city had nothing to show that it had a soul, a conscience and a measure of legitimate civic pride. He wanted to show not only the visitor and the stranger within our gates, but also the *bona fide* voters, that we were not a gross, material people intent only on money grubbing, but that we had aims and aspirations for something better and finer. To expedite matters, if no objection was offered, he proposed to appoint a committee of five members of council with full power to choose a suitable design and to institute a financial campaign to defray necessary expenses, traveling and otherwise.

The suggestion seemed to meet with general approval. In fact, the only comment came from the alderman from the fifth ward who inquired for no apparent reason, if the mayor intended to seek re-election in the fall. His Worship's reply in the affirmative closed the incident.

One or two members of the committee were of the opinion that competitive designs should be solicited from leading sculptors all over the world, but other members declared they had no time to go junketing to Hongkong, Honolulu or Timbuctoo and finally it was decided unanimously that the competition be confined to artists operating inside the second postal zone. Fast trains with club cars attached operate between Cairo, Jerusalem, Memphis, Alexandria, Carthage and other cities in the district and the members felt that possibly a little pleasure might be combined with business on these trips.

Out of the many designs, that sub-



CONTRARY TO POPULAR BELIEF TROUBLE HAS NOT CEASED WHERE THE RIVER SHANNON FLOWS

mitted by Mr. B. Durham, Winston-Salem, was selected as the most appropriate and the one most nearly representing the popular conception of the true community spirit.

Mr. Durham submitted data and photographs showing the immense popularity of this figure abroad, particularly in America where lithographed reproductions of heroic size are displayed on the streets. Meadows in the vicinity of railroad tracks and public thoroughfares in the rural districts are ornamented in a similar manner.

To sell the idea to the people, a small clay model of the proposed statue was prepared and placed on exhibition for several days in the front windows of the Mutual Trust Co., Main and Market streets. Suitable literature was displayed in connection with the figure including a card inviting contributions to the common fund.

After the committee had assured itself that the volume of contributions and pledges was sufficient to defray expenses, necessary and unnecessary, and also provide the nucleus of a modest campaign fund for the Fall election, the artist was instructed to proceed with the work and have a pattern prepared for the foundryman. A lively dispute arose over this point. The alderman from the fifth ward declared he did not propose to see the people's money wasted in this manner. He felt reasonably certain that some of the large mail order houses kept figures of all kinds in stock and he was in favor of writing for a catalog rather than to place the contract with any local foundry. His view did not appeal to the remaining members of the committee and the contract for making the casting was placed with a local firm, the Mt. Sinai Ornamental Metal Works, (S. Levi, prop.)

We are indebted to Mr. Handspike, who has had an extensive experience in this line of work, for a brief account of the process involved in producing a metal statue. He explained that nearly all castings of this character were molded and cast under one of two methods. One is known as the *lost wax* process, from the fact that the pattern consists of a wax shell which is melted and removed from between the walls of the mold and leaves a cavity that later is filled with metal.

In the second method, the one adopted by Mr. Handspike in the present instance, a plaster reproduction of the sculptor's clay model serves as a pattern. The pattern was bedded loosely in the cope and a parting was made approximately at the center line. The various pockets and *under cut* surfaces were packed full of French sand and suitable rods and hooks rammed in the larger bodies to facilitate fastening them to the main body of the mold later. After the entire drag surface of the pattern had been treated in this manner, the drag flask was set on, filled with sand and rammed. The entire flask then was rolled over, after which the false cope was removed, shaken out and replaced after the exposed surface of the pattern had been treated in a similar manner to that described for the drag. A number of small pop gates were distributed over the surface and then the remainder of the cope was filled with sand in the usual manner, rammed and lifted off. It was rolled over and placed on a pair of horses and while in that position the various small bodies of sand forming the pockets and *undercuts* were removed from the pattern and attached permanently to the face of the cope. A distinctive shape had been given the back of each one which served as a guide in relocating it in the cope.

The drag once more was rolled over and lifted away from the pattern. It then was turned on its back, or in other words, into normal position where the various pockets and *undercuts* were taken from the pattern and attached to the face. The two parts of the mold were dried and then assembled, after which the interior was rammed full of sand through openings in the ends of the flask provided for that purpose. The core was strongly reinforced throughout with rods and provided with several hooks by which it might be handled.

The cope once more was lifted and placed face up on the core oven car, where minor repairs were effected. The core was lifted out of the drag and placed on suitable stands where the molder shaved off a thickness all over the surface corresponding to the required thickness of the casting. The cope, core and drag were thoroughly dried and then reassembled and made ready for the metal.

An unexpected obstacle developed almost at the last moment when the time came to melt the metal. Mr. Handspike, who had learned his trade in Baltimore, placed a requisition for 100 pounds of new metal, pig copper and pig tin, and threatened to throw up the job when his request was refused on the ground that it was not *Kosher*. He finally compromised on a selection from all the jewelry in the city.

The casting will be cleaned today and we expect to have a rotogravure in our Sunday edition showing the completed work of art mounted on a suitable pedestal in the public square.

"It certainly is a remarkable document," I said, after I had read it through, "but how do you account for the fact that no person ever heard of it before this time?"

"Well," said Bill, "I'll tell you. If Jim had stayed in Limerick and confined himself to a modest indulgence in Shannon water, I don't believe this fragment of history ever would have been discovered. Usually he sat tightly on the water wagon, but you probably have heard of the Rocky Road to Dublin and it requires no violent stretching of the imagination to see him losing his seat in front of a local road house where a hospitable host would consider it a pleasure to fill him with gossip and mountain dew.

Whiting Corp., Harvey, Ill., recently has appointed the C. F. Bulotti Machinery Co., 67 Main Street, San Francisco, agents for its products in the state of California, to succeed Eccles & Smith Co., of the same city.

Study Manganese Effect on Steel Structure

The effect of manganese on the structure of iron carbon alloys in the annealed and normalized conditions has been determined during the course of the general investigation of iron alloys which is now being carried on by the United States bureau of standards. The general scope of the investigation is as follows:

Manganese is one of the essential materials in the manufacture of steel, since in addition to its function as a deoxidizing and desulphurizing agent, it also gives to the steel certain mechanical properties such as high tensile strength. The effect of manganese, as observed in annealed alloys, is to confer upon the pearlite a fine grain or sorbitic structure, even after slow cooling. The relative amount of pearlite present is considerably greater in alloys of high manganese content than in the corresponding ones low in this element. A pronounced increase in brinell hardness of the annealed alloy accompanies the change in structure produced by the addition of the manganese.

In the normalized alloys, a pronounced decrease in the grain size was found in those of high manganese content in addition to the structural effects mentioned above. In the annealed specimens, no noticeable difference in the grain size was detected for high and low manganese content in alloys of any carbon content. It appears, also, that manganese renders steel more sluggish and less responsive to structural changes than other elements which produce a similar lowering of the critical temperature. While the results of these tests will not warrant any definite conclusions concerning the use of manganese as a strengthening element in steel, the results strongly support the previous recommendations of metallurgists concerning the advantages to be gained from the use of higher manganese, particularly in low or carbon steels.

Contraction of Aluminum Alloy Varies

As the result of an investigation of the contraction and shrinkage of aluminum alloys conducted by Robert J. Anderson, metallurgist, at the Pittsburgh experiment station of the United States bureau of mines, it has been shown that contraction of a series of 40 alloys varied between the limits of 0.95 and 1.80 per cent, depending upon conditions, and that it is advisable to make accurate pattern allowances for the various alloys in casting practice. This only applies to the metal and has no reference to the variation in contraction depending on the shape of the pattern.

Dried Mold Solves Problem

Changes in the Position of Gates and Risers and the Application of Chills at Various Points Were Tried Without Avail While the Mold Was Made in Green Sand

BY J. F. REDFEATHER

TO APPRECIATE the difficulties that may be encountered in the production of any casting it is well to have an understanding of the use of the parts as well as to be familiar with the manufacturing and inspection specifications. The entire surface of the casting shown in the accompanying illustration is finished. A steel band is shrunk around the outside and the space between the band and the casting is filled with mercury. The device is used as a flywheel on a delicate instrument and therefore must balance perfectly. It is tested for balance after it is machined and rejected if found not almost true. In the final assembly it is balanced by drilling fine holes in the heavy side of the disk. To insure nonleakage of the mercury the cavity is tested under 30 pounds air pressure before the mercury is introduced.

Inspection tests disclosed that visible defects in the casting were causing practically all the leaks and were due to an open grain structure. Due to the fact that nearly all the castings are thin sectioned and machined, the iron is soft. Typical analysis shows the combined carbon to be 0.04 per cent.

The various methods tried out in making the molds are shown in the accompanying illustrations. Fig. 1 shows the method employed when the job first started. The pattern was made with a loose lower flange and the mold was made in a three-part snap flask. The metal was gated into the lower flange and a riser was taken off the upper flange. Serious leaks appeared in these castings at the point marked *A* where the disk joins the rim. In the second method shown in Fig. 2 chills were rammed up in the sand at this point and the leakage stopped. However, new leaks made their appearance opposite the two gates indicated at *B* Fig. 3. We attempted to stop these leaks by cutting a runner gate all around the lower flange with a number of small feeder gates as shown in Fig. 3, but leaks still appeared in the corner where the rim and flange meet opposite the runner.

In the next method illustrated in Fig. 4 a chill was placed opposite the feed gates and the chills and the chills between the disk and rim also were applied. The leaks disappeared from the lower flange and appeared around the top flange and rim as indicated at *C* Fig. 4. Owing to the impractibility of carrying, or, holding chills in the cope, or cheek, to protect the upper rim we discarded the chills altogether and made the molds in dry sand and experienced no further trouble from leaky castings.

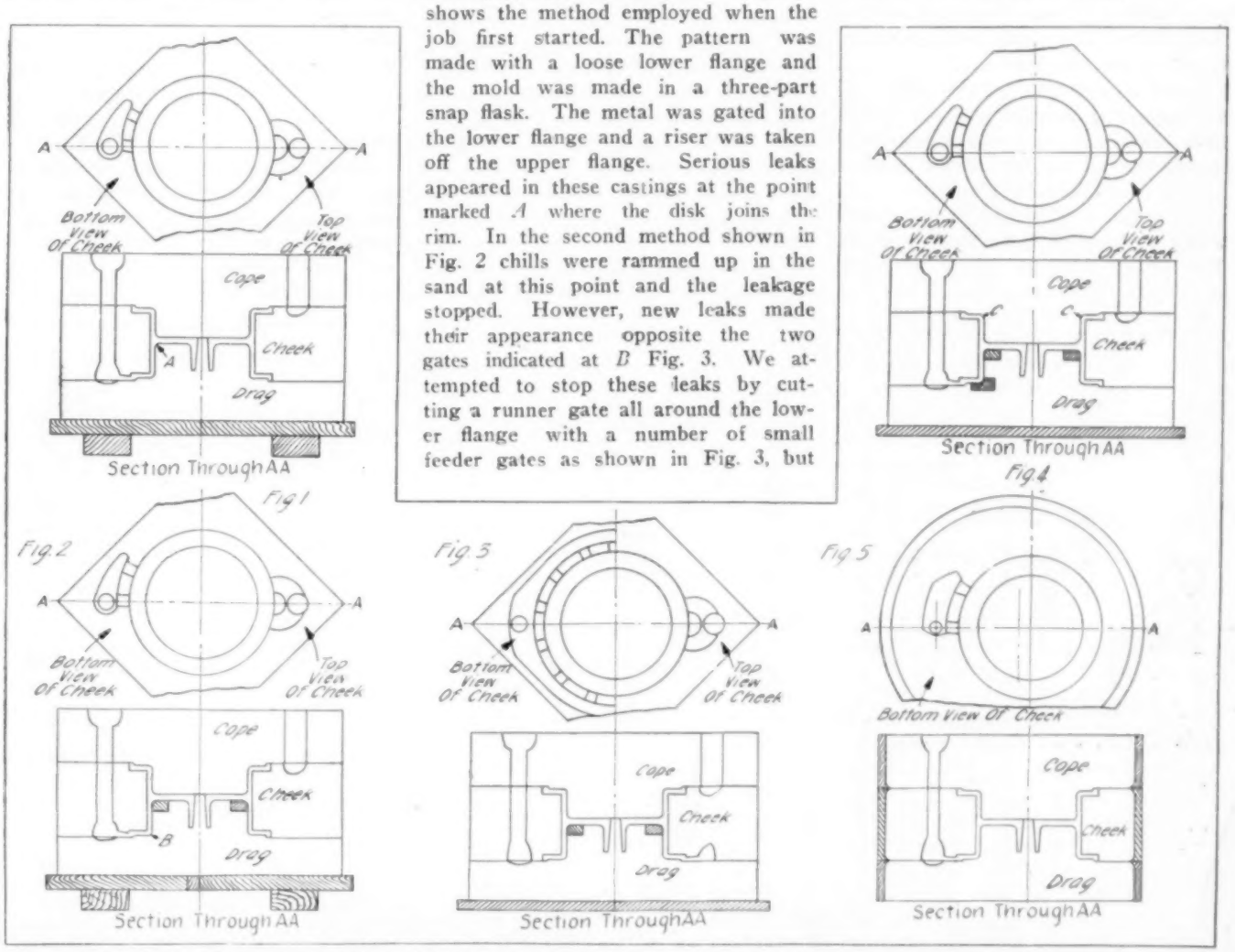


FIG. 1—METHOD IN USE WHEN INVESTIGATION STARTED FIG. 2—CHILLS APPLIED WHERE DISK JOINS RIM FIG. 3—RUNNER ALL THE WAY AROUND BOTTOM FLANGE FIG. 4—ORIGINAL STYLE GATE AND TWO SETS OF CHILLS FIG. 5—DRY SAND MOLD WITHOUT CHILLS

Methods for Chain Wheels

A Patternmaker with a Working Knowledge of Foundry Practice Will Ignore Details on the Drawing and Make a Pattern in the Best Manner to Meet Local Conditions

BY M. E. DUGGAN

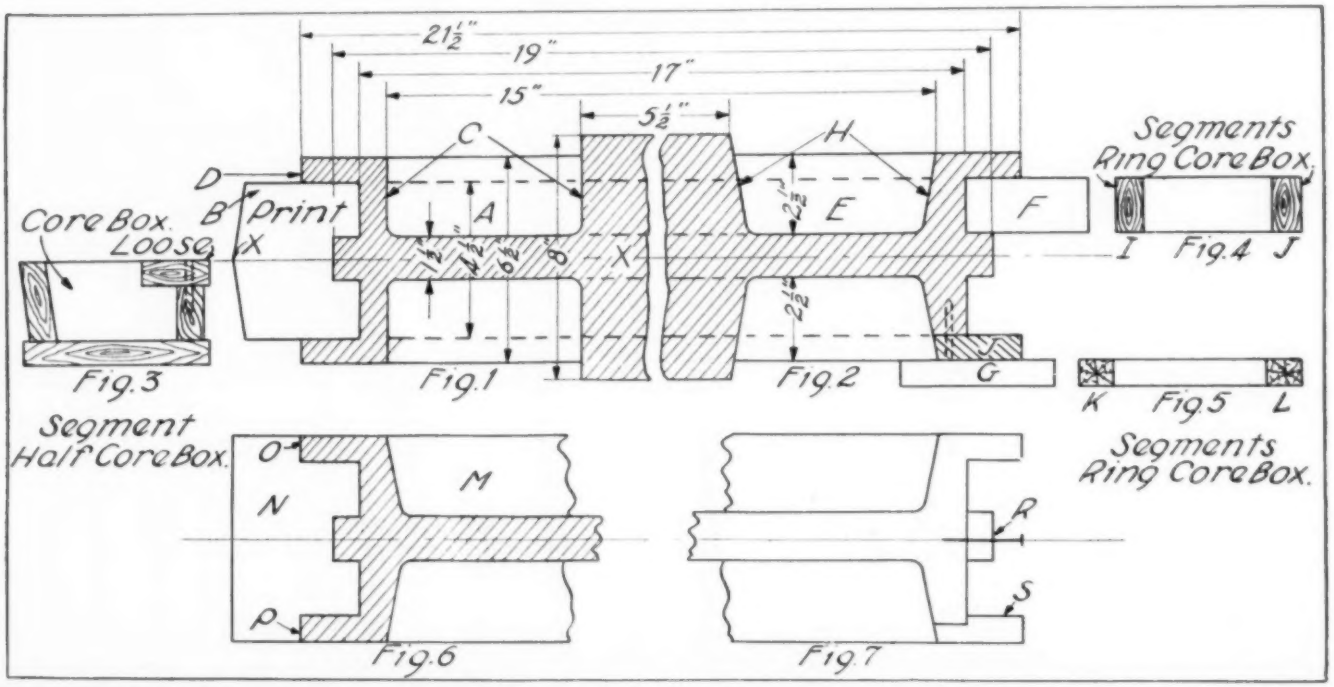
FOUR different methods are shown in the accompanying illustration for making the pattern for a chain wheel with a rib surrounding the circumference on the center line. The first two merely are given as horrible examples of how a pattern for this job should *not* be made. The second two are examples of practical patternmaking and a choice in their adoption depends to a considerable extent on local circumstances. The method shown in Fig. 6 when one man makes the cores and one the molds lends itself readily to large production and comes well within the scope of inexperienced foundrymen. The method shown in Fig. 7 is essentially a molder's job. The lower flange is made loose and the center rib *R* is made in segments designed to draw in. The mold is made in a 3-part flask, but it has the advantage that when the casting is poured it will come out of the sand without any unsightly fins to chip out of the grooves. The grooves also will be perfectly round and uniform, a condition rarely secured where a ring core is made in segments. The pattern shown in Fig. 1 was made split through the center on the line *X X*, to be molded one half in the drag and one half in the cope. The man who made it that way had two reasons to justify himself. One was that he had been taught as a boy to split all wheels of that character and the other was because the lines shown at *C* were drawn exactly at right angles to the horizontal center line and he felt that the lines of his pattern should conform strictly to the lines on the drawing. The argument may be advanced that the draftsman should have given the lines a taper as shown at *H* Fig. 2, but my contention is that the patternmaker should know enough about foundry practice to make minor changes of that kind on his own initiative. Draftsmen are not infallible and many of them have little or no conception of foundry practice.

The foundryman's objection to using the pattern shown in Fig. 1 lies in the fact that he has to cut a gap in all the bars in his cope to accommodate the ring and hub. Another reason is that an element of danger, either of a crush or a runout, always is present where a cope is closed down over a core that stands above the parting line. In this particular instance the ring core was made in six segments in a half box as shown in Fig. 3. The loose piece designed to form the rib was attached loosely to the top instead of being dropped down on the inside and held in place with two long nails.

The circumference only of the upper, lower and center flanges was to be machined, the remainder of the outside face was to remain as it left the sand. For this reason it was essential the skin be as smooth as possible something not easily done with 12 half-segment cores.

A one-piece pattern simplifies the work of the patternmaker and molder. Further, it is strong and will retain its shape wherever it is put, whether in the pattern shop, pattern storage or foundry. A plain flat cope is employed to make the mold and this feature insures that there will be no runouts, crushes or shifts when the mold is closed.

The method illustrated in Fig. 2 has some commendable features, but taken as a whole it is not a suitable pattern to go into a foundry. It is rather an example of misdirected skill and ingenuity. It is made in one piece



THE METHODS SHOWN IN FIGS. 1, 2, 3, 4 AND 5 ARE TO BE AVOIDED—IN FIG. 6 A DRY SAND CORE FORMS THE ENTIRE EXTERIOR OF THE RIM—IN FIG. 7 THE LOWER FLANGE AND CENTER RIB ARE MADE LOOSE AND THE MOLD IS MADE IN A 3-PART FLASK

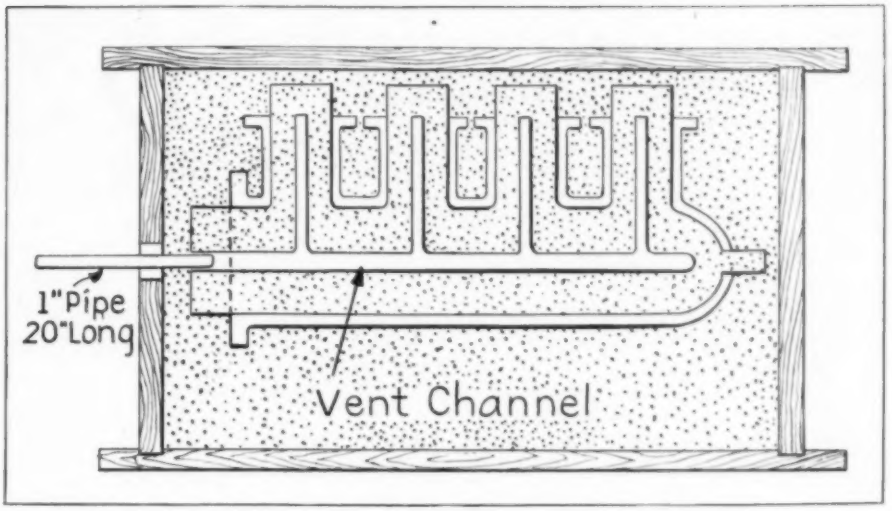
with the exception that the lower flange is made loose. The patternmaker ignored the lines on the drawing and tapered the sides as indicated at *H*, but in my opinion he made an error in providing two coreboxes to form the flanges on the rim. He proposed that the molder should ram the drag part way, then draw the flange marked *J*, cover the cavity with a set of segment ring cores *G*, then finish ramming the drag and roll it over. The core *F* also made in segments was designed to form the groove above the center rib.

Plate Patterns Warp When Glued

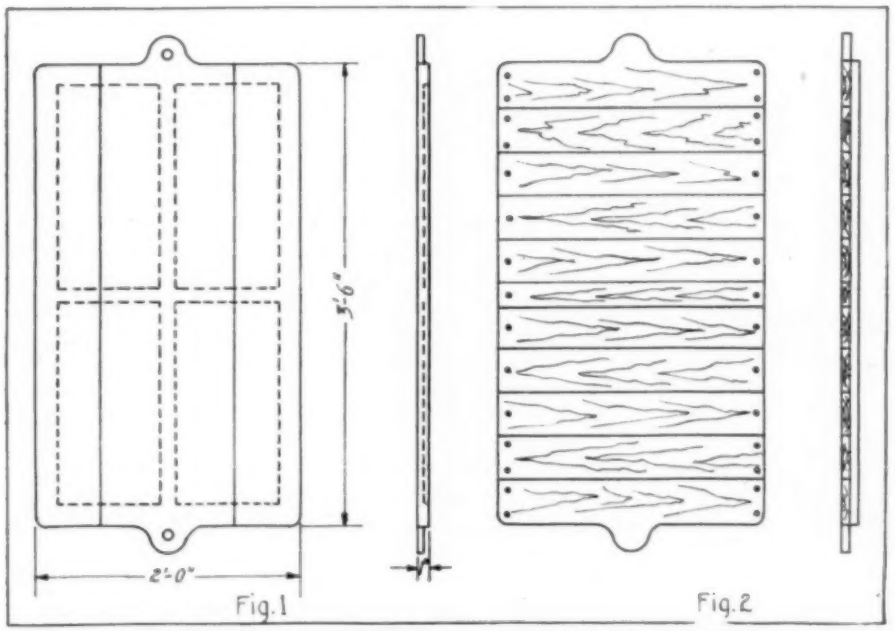
By J. W. Broadbent

Patternmakers accustomed to making flat plates realize the necessity of arranging the boards in such a manner that alternate expansion and contraction will not throw the entire pattern out of shape. Men who are not familiar with these peculiarities usually require an actual demonstration before they become convinced that any special precautions are required. The pattern selected for illustration was designed for a pattern plate for a molding machine. It was supposed to finish 1 inch thick and was recessed on one side for lightness. In accordance with accepted foundry practice for securing a clean face, the flat side was made to mold in the drag. Sometimes patterns of this character are provided with stiff battens, but the practice involves extra work in the foundry, where the cope bars must be cut to clear the battens and the impression left by the battens afterward filled with sand.

In this instance the job was given to a man who formerly had been a cabinetmaker, partial to the glue pot and invisible joints. He was given general instructions on how to make the pattern, including the addition of ¼-inch top and bottom for machine finish. However, he did not propose to prostitute his art by making a plate in the rough and ready way which had been outlined. He matched and glued boards longitudinally, and glued and screwed ribs on one side as shown in Fig. 1. The pattern was varnished and given a piano finish and really looked beautiful until the following morning when the maker discovered that it was warped out of shape. He tried to remedy the defect by planing down the high corners, but found that the plate then was too thin. He made a second pattern as shown in Fig. 2, by arranging the boards transversely and omitting the glue between the joints. He insisted on light tight joints between the boards and used a clamp while screwing them in place. This pattern did not warp to the extent of the first but it warped enough to condemn it. On the third attempt he followed instructions literally. He took the second pattern apart, planed ⅛-inch off the sides of each board and then replaced them in open formation. The result surprised him. The pattern was straight and he was assured it would remain straight even when subjected to the severe distortion strains incident to use in the foundry.



THE VENT FROM THE ENTIRE CORE IS LED TO ONE POINT AND CARRIED THROUGH A 20-INCH LENGTH OF 1-INCH PIPE INSERTED THROUGH A HOLE IN THE JOINT OF THE FLASK



IG. 1—THIS PATTERN WARPED BECAUSE THE BOARDS WERE LAID LONGITUDINALLY AND GLUED TOGETHER AT THE JOINTS FIG. 2—IN THIS INSTANCE THE BOARDS WERE NOT GLUED BUT THEY WERE JOINTED TIGHTLY AND HELD WITH A CLAMP WHILE THEY WERE SCREWED IN PLACE. THIS PATTERN ALSO WARPED

Vent Pipe Protects Wood Flask from Flame

By M. R. Burns

In the accompanying illustration is shown a device I adopted to prevent the flame from a core vent burning the joint of the flask. The casting has to be left in the mold for about an hour after it has been poured. Instead of taking a vent from every opening in the casting and conducting it either through the top of the cope, or through the joint of the flask, I led all the vent channels toward a single opening in the large end of the pipe. After the mold is closed I insert the end of a 1-inch pipe, 20 inches long, through a hole provided in the end of the flask for that purpose.

THE FOUNDRY

Registered U. S. Patent Office

A semimonthly journal devoted to all branches of the foundry trade

Published by
THE PENTON PUBLISHING CO., CLEVELAND, O.

BRANCH OFFICES

BOSTON.....426 Old South Bldg.
CHICAGO.....1147 People's Gas Bldg.
CINCINNATI.....504 Edwards Bldg.
NEW YORK.....2203-2206 No. 220 Broadway
PITTSBURGH.....2148-49 Oliver Bldg.
SAN FRANCISCO.....675 Monadnock Bldg.
WASHINGTON, D. C.....84 Home Life Bldg.

FOREIGN OFFICES

BIRMINGHAM, ENGLAND.....Prince's Chambers
LONDON, ENGLAND.2-3 Caxton House, Westminster, S.W. 1
PARIS, FRANCE.....224 Rue de Rivoli
Cable address, IROTRAPEN, London

SUBSCRIPTION

United States and Mexico.....$3.00 a year
Canada.....$4.00 a year
Great Britain and other Foreign Countries.....$4.00 a year
Single Copies.....25 cents
Copies published three months or more previous to date of current issue, 50 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 1st and 15th of the month preceding date of publication.

Member, the Audit Bureau of Circulations, Associated Business Papers, Inc., and National Publishers Association

Entered at the Post Office at Cleveland as Second Class Matter

Copyright 1922 by The Penton Publishing Co.

Contents

	Page
How Sanitary Ware Is Made	935
Method for Joining Metal Pattern Halves	941
Experiments in Pig Iron	941
Makes Tax Report Cost Basis	942
A. F. A. Co-operates with Testing Society	945
Modern Foundries of Central Europe—II	946
Research Group Meets	951
Silica Brick Production	951
Illustrates Pipe Casting	951
Cupola Malleable Production	952
Heat in Resistance Furnace	956
Proposes Line of Foundry Research	957
Cleveland Headquarters	957
Casting of Aluminum Bronze	958
How and Why in Brass Founding	960
Copper Castings for Blast Furnace Tuyeres	960
How To Feed Test Pieces	961
Character of Alloys Is Shown by Analysis	961
Nickel Silver Melts at High Temperature	961
Equipment for Treating Furnace Residue	961
Designs New Electric Furnace	962
British Institute Holds Special Election	963
Bill Receives a Remarkable Document	964
Study Manganese Effect on Steel Structure	966
Contraction of Aluminum Alloy Varies	966
Dried Mold Solves Problem	967
Methods for Chain Wheels	968
Plate Patterns Warp When Glued	969
Vent Pipe Protects Flask from Flame	969
Problems the Same Then as Now	970
Trade Outlook in the Foundry Industry	971
Comings and Goings of Foundrymen	972
Recalls American Visit	972
Philadelphia Foundrymen	973
Plan December Meeting	973
Installs Warning Bell on Sand Cutter	973
Nozzles Adjustable in Sandblast Barrel	973
Builds Oil Engine Air Compressor Unit	974
Applies Leverage To New Lifting Pin	974
New Press Heat Treats Saws Electrically	975
Designs Bag Holder for Packing Castings	975
Small Cupola Set Up for Emergency Jobs	975
Builds Crane for Use in Railway Shops	976
Design New Type Power Operated Sifter	976
Pittsburgh Foundrymen	976
Equipment Business Varies	977
What the Foundries Are Doing	978
Trade Publications	978

Problems the Same Then as Now

PRESENT day foundrymen who, for one reason or another, are prone to consider that the industry has fallen on evil days should derive a considerable measure of consolation from a perusal of some of the early volumes of THE FOUNDRY. In the minds of men whose active experience dates back 30 years, the glamor of time hangs over the so-called good old days. It is apt to distort their vision and color their statements when referring to conditions obtaining at that time. This point, with equal justice, may be raised in connection with younger men who have gained their experience within the past few years and who in the sublime faith of egotistical youth are quite sure that old time foundrymen had it pretty easy. The opinions of both classes of men is taken at its face value among their contemporaries and rarely is disputed. However, an opinion is only an opinion and while in one case it may be right, in a second case it is just as liable to be all wrong. In either event it cannot be compared in accuracy or in importance with the written record.

The Philadelphia Foundrymen's association was in existence in 1892 and extended accounts of its monthly meetings appeared regularly in the first volume of THE FOUNDRY. The material was furnished by Howard Evans who was then and has been continuously ever since, secretary of the Philadelphia Foundrymen's association. With but few exceptions the subjects discussed and the problems confronted were the same as those which engage the attention of similar organizations today. The price cutter was abroad in the land in those days and figures are quoted that will tax severely the credulity of men accustomed to buy or sell castings within the past five years. For example, considerable interest was aroused at one of the meetings when a member reported that the price of pipe castings ranged from $1.05 to $1.17, according to different sizes, and special castings had held their own at $2.50 per 100 pounds. Certain makers had gone below those prices, but he felt there had been no justification for making the cuts. In several instances makers had cut prices simply because they felt the orders belonged to them. The lowest price he had heard reported on general castings was $1.65 per 100 pounds on a lot of 1200 lamps posts in New York. The post was made in three pieces and weighed 350 pounds. He considered this price a record breaker since the lowest price ever quoted formerly was $1.79. A car wheel manufacturer reported that his bid of $7.50 a wheel on a lot of 2400 had been turned down in favor of another interest which had secured the business at $6.75. The market reports on another page of the same issue indicate that the price of pig iron f.o.b. cars Philadelphia ranged from $14.00 to $20.00, and Connellsville foundry coke was quoted at $5.65.

The educational purpose of the association was featured to some extent at every meeting and papers were presented by men who held prominent positions at that time. The cupola with its many idiosyncrasies came in for a fair share of attention, and the same may be said for molding, core and facing sand. With a few minor changes, involving methods and equipment introduced in recent years, an account of a foundrymen's meeting held in 1892 might serve for one held in 1922. Indeed the only outstanding difference lies in the last paragraph of these ancient chronicles wherein it is stated that at the banquet following the meeting, toasts were proposed and presumably honored.

Trade Outlook in the Foundry Industry

GENERAL trade tendencies show such irregularity that this has caused a halting and hesitancy in some branches of industry. While the prices of some products continue to rise, those of iron, steel and coke are slowly dropping. Of course, the former increase in price in iron and steel products was largely caused artificially by the coal strike and the railroad tie up. The effects from both of these conditions now are waning; coal is being produced at a constantly increasing rate, having attained a daily average of 1,850,000 tons; while the car loadings are decreasing, although still ahead of the average for this time of the year.

Pig Iron Slow

Naturally consumers are hesitating to buy for more than their immediate needs in a falling market and sales of pig iron have been slow. However, signs tend to indicate that the price of pig iron has reached nearly the bottom and some few foundrymen are purchasing iron for the first quarter, while the sellers in all but the Buffalo market are holding firmer to their prices. Undoubtedly a large requirement is being backed up and will come on the market in the near future. This is indicated by inquiries for approximately 200,000 tons of pig iron which are being put out quietly in all parts of the country. An intimation of what may happen when the buying movement starts is shown by the Alabama furnaces which after a large volume of sales are talking about stiffening prices, although production costs in this district are between $17 and $20 a ton as against a cost of about $30 for furnaces in eastern Pennsylvania. These latter furnaces must compete with foreign iron which is coming into this country in large tonnages both to the Atlantic and to the Pacific coast. Some of this iron is higher in sulphur and phosphorus than American melters are accustomed to while other irons meet standard specifications.

Prices of Raw Material for Foundry Use

CORRECTED TO NOV. 23

Iron		Scrap	
No. 2 Foundry, Valley	$27.50 to 28.00	Heavy melting steel, Valley	$20.50 to 21.00
No. 2 Southern, Birmingham	23.00 to 24.00	Heavy melting steel, Pitts	20.00 to 20.50
No. 2 Foundry, Chicago	30.00	Heavy melting steel, Chicago	17.00 to 17.50
No. 2 Foundry, Philadelphia	30.13 to 31.64	Stove plate, Chicago	18.50 to 19.00
No. 2 Foundry, Buffalo	27.00 to 27.75	No. 1 machy. cast, Chicago	22.50 to 23.00
Basic, Valley	27.00 to 28.00	No. 1 cast, Philadelphia	22.00 to 23.00
Basic, Buffalo	27.75	No. 1 cast, Birmingham	19.00 to 20.00
Malleable, Chicago	30.00	No. 1 cast, Buffalo	21.00 to 22.00
Malleable, Buffalo	27.75 to 28.25	Car wheels, iron, Pittsburgh	22.50 to 23.00
Coke		Car wheels, iron, Chicago	24.50 to 25.00
Connellsville foundry, coke	$8.00 to 8.50	Railroad malleable, Chicago	23.00 to 23.50
Wise county foundry, coke	7.00 to 8.00	Agricultural mal., Chicago	23.00 to 23.50
		Malleable, Buffalo	22.00 to 23.00

Stocking Automobiles

Silvery irons have recently been reduced $2 a ton and Jackson county 8 per cent silicon iron was sold at $37.50 a ton. These grades of iron have had quite a little competition from electric furnace ferrosilicons ranging from 13 to 14 per cent silicon, amounts of which have been sold to automobile interests. Scrap prices have been halted in their almost continuous rise since the middle of 1921, having reached their high point in October and reacted slightly. In contrast to the hesitancy in buying by the foundry interests, is the optimism of the manufacturers of automobiles whose business has kept up unexpectedly well for this season of the year. It is expected that the November production of cars and trucks will not fall short of the October record of 244,000. Some of the companies are just beginning to be caught up sufficiently with the demand for closed cars to be able to give promise of reasonably quick deliveries. Judging that the spring demand will be heavy and that prices of materials are more apt to go up than come down a number of automobile firms are planning to build up a heavier stock of cars during the winter than they have carried for some years. One prominent foundry making automobile castings is remodelling its shop and preparing to start on a hundred per cent basis the first of the year.

Some Lines Active

Reports from different sections of the country indicate that gray-iron foundries are operating on an average of between 50 and 60 per cent of capacity depending upon what line they are in. Prospective buying by the farmer who is securing better prices for his crop has stimulated the agricultural implement business. Three implement manufacturers report October sales 40 to 62 per cent larger than for the corresponding month last year. Building of railroad cars and locomotives still continues active and a number of large inquiries are out, both for cars and for locomotives. Thus the foundries producing castings for new railroad equipment are assured a prolonged continuation of their activity. Equipment for the oil country is keeping busy the foundries in this line of work. Stove foundries also are operating near capacity. Some slackening is noticed in demand for cast-iron pipe but the shops mostly have orders enough ahead to keep them busy for a couple of months. At present the outlook in the building trades is distinctly encouraging. The new construction in October totaled $204,260,134 compared with $197,626,498 in September and $168,536,555 in October last year, according to returns from 161 cities compiled by *Bradstreet's Journal*.

Aluminum Price Increase

Nonferrous foundries maintain their production at a somewhat better rate than those producing gray iron castings. The advance of 2 cents in the price of aluminum, effective Nov. 22, announced by the Aluminum Co. of America came as a surprise to the trade in view of the two previous advances made since the duty on aluminum was increased 5 cents a pound in September. This will give the foreign producer more opportunity to enter the market. Prices of nonferrous metals, based on the *Daily Metal Trade* of Nov. 23 follow: Casting copper, 13.40c to 13.50c; electrolytic copper, 13.87½c; Straits tin, 36.00c; lead, 7.15c to 7.20c; antimony, 6.50c; aluminum, No. 12 alloy, producer's price, 24.00c to 24.20c, and open market, 22.00c to 23.00c. Zinc is 7.00c for prompt delivery, 6.95c, first quarter.

Comings and Goings of Foundrymen

C. H. GALE has resigned his position as superintendent of foundries of the Pennsylvania Malleable Co., a subsidiary of the Pressed Steel Car Co., Pittsburgh, to retire after nearly a half century of activity in foundry work.

Mr. Gale entered the foundry of the Michigan Stove Co., Detroit, as apprentice. After 6 years he went to Europe and spent 1 year working in foundries in France and Germany, returning to Detroit where he entered the employ of the Michigan Malleable Iron Co. From here he went to Springfield, O., to become connected with the International Harvester Co., and later was transferred to the company's foundry at Hamilton, Ont., Canada. In 1905 he accepted the position from which he has recently resigned, successively having filled the positions of molder, timekeeper, foundry foreman and superintendent.

Mr. Gale has contributed a number of articles to foundry literature, and taken an active part in the work of the American Foundrymen's association as well of local organizations. He now is trustee and past president of the Pittsburgh Foundrymen's association. Mr. Gale's immediate plans are to spend the winter in Florida and then to devote some time to travel.

George Davies, Pilling & Co. Philadelphia has returned from a trip to Europe.

Schuyler Merritt, vice president of the Yale & Towne Mfg. Co., Stamford, Conn., has been re-elected to congress from the Fourth Connecticut district.

Fred J. Meyers has been promoted to the position of office manager for the Dayton Malleable Co., Dayton, O. made vacant by the resignation of A. C. De Bruin.

Judson A. Parsons has resigned his connection as pig iron salesman with the Bethlehem Steel Co. in the New York territory. He will resume the practice of law in Rochester, N. Y.

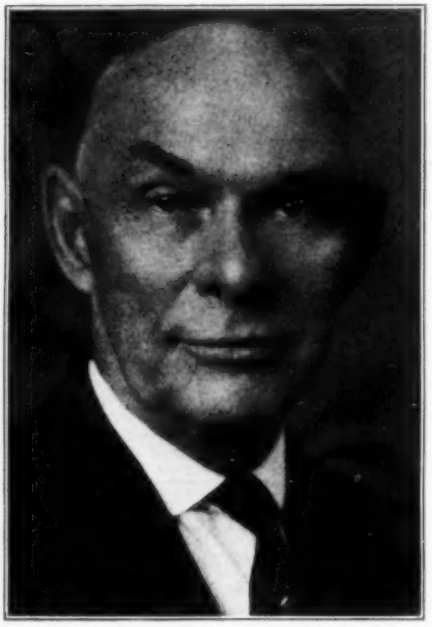
W. W. Sayers, Link Belt Co., Chicago, has been made chief engineer of the company's Philadelphia works and Eastern operations. Mr. Sayer will make his headquarters in that city.

L. J. Creelman has accepted the position as structural engineer for the F. A. Coleman Co., Cleveland. Mr. Creelman was formerly chief engineer of the Blaw-Knox Co. and located at its Baltimore office.

Larry J. Barton, formerly consulting metallurgical engineer, San Francisco, has taken over the management of the new electric furnace foundry of Dibert, Bancroft & Ross, New Orleans, and will be located in that city.

Benjamin Drewes has resigned his position as foundry superintendent for the Kissel Motor Car Works, Hartford, Wis., to become assistant superintendent of the foundries for the Fairbanks Morse Mfg. Co., Beloit, Wis., assisting R. J. Barr.

Wesley Lambert, metallurgical expert of J. Stone & Company, Deptford, London, nonferrous metal founders and alloy manufacturers, has arrived in the United States on a brief business trip. Among the products of J. Stone & Co. are large bronze propellers.



C. H. GALE

Dale D. Butler, president of the W. & B. Douglas Co., Middletown, Conn., maker of pumps, has been elected president of the Middletown chamber of commerce, succeeding John A. Ruffin, removed to New York.

L. R. Bremser, associated for 13 years with the Gardner Governer Co., has been made manager of the Chicago office of the Norwalk Iron Works Co., Norwalk, Conn. The Chicago office of this company, which builds compressors and refrigerating machinery, will be located at 627 W. Washington boulevard.

Frank Anderson, vice president of the National Association of Purchasing Agents, has resigned as purchasing agent for the Llewellyn Iron Works, Los Angeles, to become president of the Atlas Brass Foundry, Inc., Los Angeles. H. W. Christenson, assistant purchasing agent for the Llewellyn company has been appointed to succeed Mr. Anderson.

G. Harold Gilpatric, secretary and treasurer of the Putnam Foundry & Machine Co., Putnam, Conn., has been re-elected state treasurer of Connecticut.

Jean Carles, engineering delegate of the Association Technique de Fonderie de France, has resigned that position to become manager of a foundry at Amiens, France.

Herbert F. Perkins, a vice president of the International Harvester Co., Chicago, who has been in charge of all manufacturing and raw materials operations, has been assigned to assist the president in the administration and general management of the company's affairs and to act as president in the latter's absence. Cyrus McCormick, Jr., formerly works manager, has been elected vice president in charge of the company's plants in the United States, Canada and Europe. George A. Ranney, secretary and treasurer of the company, has been elected vice president and treasurer. E. A. Johnston, manager of the experimental department, has been made director of engineering, a position just created.

Recalls American Visit

At the open meeting of the Staffordshire Iron & Steel institute, Nov. 10, Joseph Payton was re-elected president and gave a general survey of trade conditions from the economic point of view showing the injurious effect upon business of the violent exchange fluctuations. He said there are now signs of improvement indicating that the worst has passed.

F. J. Cook, who presented the exchange paper at the Rochester convention of the American Foundrymen's association gave an address describing his experiences in America during his visit. Examples were given of the abounding hospitality everywhere met. He said he was greatly impressed by the huge size of the plants and the output tonnages. A Pittsburgh company has a foundry 1200 feet long, larger than any foundry, he believed in Great Britain. The castings produced there do not exceed 1500 pounds and the bulk of the output weigh about 500 pounds each, yet it produces 150 tons per day. One aluminum com-

pany turns out 20 tons per day, a large quantity in that light material.

The general policy Mr. Cook found to be to cut out manual labor, which is done by overhead transport and in some cases underground transport too, by means of grids through the floor. While the wages average about three times that of the Englishman the output is twice as great. Most of the manual labor is done by foreigners with Americans and Englishmen largely in positions of supervision.

The speaker remarked that few Englishmen would be willing to work at the pace maintained by the manual laborer. The quality of the patterns was said to be quite good and frequently equal to English. But the speaker said he considered American foundries are far behind the British standard for floor works. Apparently the American is satisfied if the product is good enough for the job, whereas the Englishman frequently goes to the other extreme.

Mr. Cook said Englishmen have no idea of American achievements in producing malleable iron. The National Malleable Castings Co. produces several times more than the entire output of Great Britain. At one place the daily production was 200 tons and at another 98 tons. Undoubtedly in malleable work Americans are as far ahead of the Englishmen in quality and output as they are behind in floor molding. The American malleable castings are much softer than those made in Great Britain.

The way in which the castings were dumped into the annealing pots without careful packing, Mr. Cook said, strongly impressed him. Also the annealing temperature is much below that used in Great Britain, 800 degrees Cent. being a usual figure. However, it was said the physical tests show that while the Englishman gets only 5 to 8 per cent elongation 15 per cent in America is nothing unusual, and the tensile strength is around 55,000 pounds per square inch.

Philadelphia Founders

Multiple melting of steel and gray iron was discussed at the monthly meeting of the Philadelphia Foundrymen's association, held at the Manufacturers' club of that city, Nov. 8, by Frank W. Brooks, chief engineer, Wm. Swindell & Brothers, Pittsburgh. Mr. Hanff of the same firm spoke on electric annealing of steel and gray iron castings in the foundry, to show the advantages and disadvantages of continuous heat treatment. Both addresses were illustrated by lantern slides.

Plan December Meeting

The New England Foundrymen's association in planning its December meeting announces a program of industrial films including views of centrifugal molding machines in operation and other modern practice. The meeting will be held at the Boston Athletic club instead of at the Exchange club, Boston, as has been the custom in the past.

Installs Warning Bell on Sand Cutter

E. J. Edwards

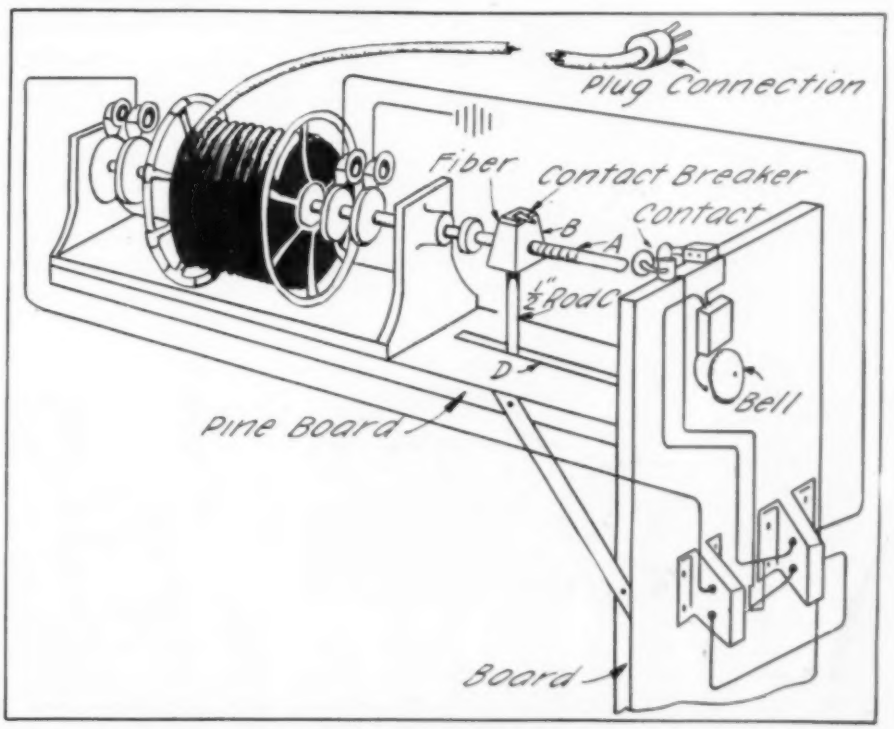
A method of attaching an electrically operated bell on a sand cutter, designed to warn the operator when the cable is paid out to within 5 feet of the end, is shown in the accompanying illustration. When the bell rings the operator knows it is time to change the plug connection. Before the bell was installed the operator frequently misjudged his distance, or forgot to change connections, in either case causing a more or less serious breakdown.

An ordinary 1-inch standard cap bolt *A* was bored 5/8-inch on the head end to fit over the projecting end of the cable reel shaft. A 2-inch cast iron cube *B* was converted into a nut by tapping and threading a hole through it. A ½-inch hole was tapped into what was destined to be the lower side of this nut when in operating position. One end of a ½-inch rod *C* was screwed into the nut and the other end extended through a slot *D* in a pine board 1 x 6 x 2 inches. A piece of fiber attached to the upper side of the nut acts as an insulation and a piece of copper attached to the fiber serves as a circuit breaker, as shown in the illustration. Two controller fingers are fastened to a 1 x 6 x 16-inch pine board set up at right angles to the board containing the slot. As the cable reels or unreels, the nut travels back or forth on the bolt. When the cable is unreeled to within 5 feet of the end, contact is made with the two fingers and the bell rings.

Electrical connections are made by using two 110-volt bell transformers connected in multiple as the current to the machine is 220 volts. From the transformers the connection extends to the bell and finger and from the other finger to the bell which reduces the current sufficiently to ring the bell. This method was adopted in preference to using dry cell batteries. With the exception of one connection leading to the bell, all connections were soldered. The device has eliminated delays, extra labor and possibility of accident to employes from the falling conduit.

Nozzles Adjustable in Sandblast Barrel

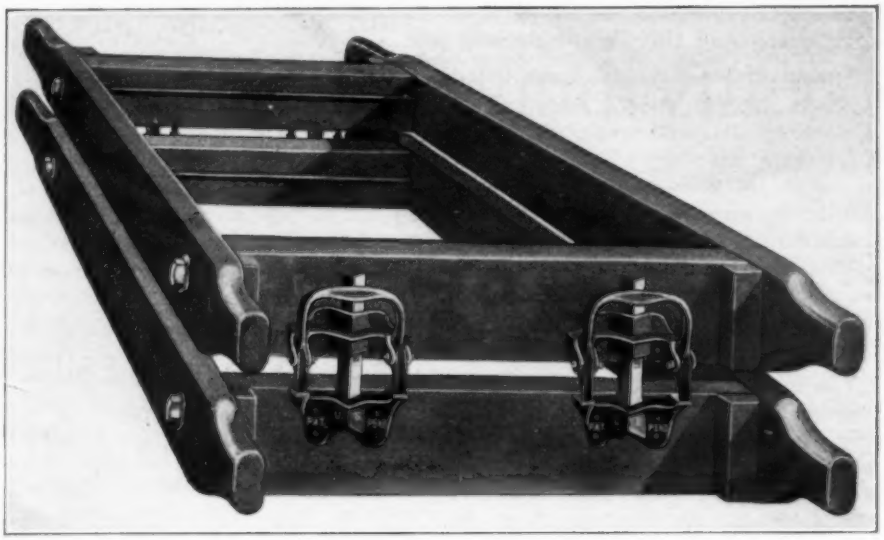
Economy of operating cost through increased efficiency of blasting action and durability of the equipment are among the claims set forward for the new sand-blast barrel recently intro-



A NUT SLIDING BACK AND FORTH ON A LONG BOLT MAKES AND BREAKS CONTACT

duced by the Pangborn Corp., Hagerstown, Md., and shown in the accompanying illustration. Experience of the manufacturer has shown that cleaning capacity in sandblasting is governed by the distance of the nozzle from the castings, and the angle of the application of the sand. In the device shown the nozzles may be adjusted both horizontally and vertically to secure the most effective position when handling varying classes of castings, to meet the changing sizes of the individual pieces and the position within the barrel.

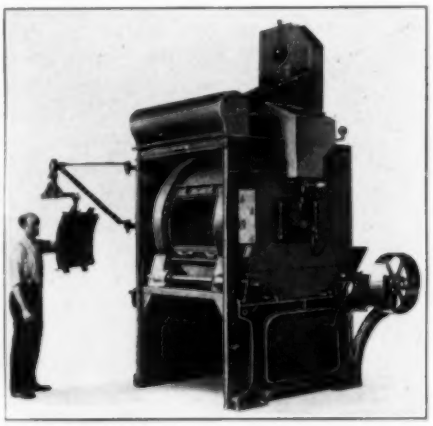
A mechanical separator assuring constant and perfect separation of the abrasive for reuse is obtained by a ribbed roller driving against a shaft protected by heavy rubber tubing. The tubing takes the entire wear and may be replaced quickly and cheaply. The barrel door opening is reinforced inside and out with plates and angles. Steel tires pinned to head castings and driving on manganese steel rollers, with front rollers idle and equipped with roller bearings, provide smooth even traction with little wear. Steel driving sprockets and chain operate in an oil bath in a dust tight case. The clutch is simple and positive. The machine is made in two sizes; one with a drum 30 x 40 inches and the other 40 x 50 inches.



THE HANDLE ON THE PIN LIFTS THE FLASK 1¼ INCHES

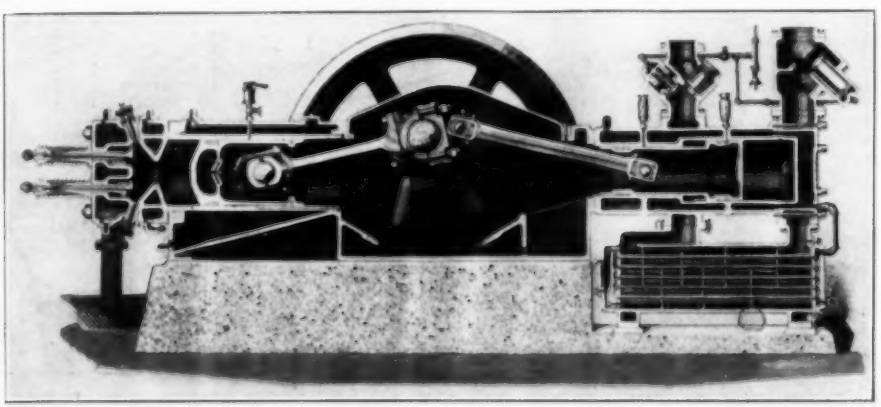
Builds Oil Engine Air Compressor Unit

The Ingersoll-Rand Co., 111 Broadway, N. Y., recently has developed a direct-connected oil engine air compressor unit. A cross sectional view of the oil engine and compressor is shown in the accompanying illustration. The unit of which the 100-horsepower engine forms the prime mover has the air cylinder in line with the power cylinder, but on the opposite side of the crankshaft. For 100 pounds pressure, a two-stage air cylinder is provided. The air intercooler is mounted below the air cylinder and forms a support therefor. For air pressures less than 100 pounds, a single-stage air cylinder is provided, which is connected to the oil engine frame by a distance piece. For both single and two-stage work the cylinder is double acting.



NEW TYPE SANDBLAST BARREL

In the 50-horsepower size the air cylinder is vertical and is mounted on top of the engine immediately above the crankshaft. This makes it possible to mount the unit on a flat car or truck for use in portable work. The height has been kept less than 8½ feet.



CROSS SECTION OF NEW TYPE OF OIL ENGINE DRIVEN AIR COMPRESSOR UNIT

The engine employs a system of fuel injection which eliminates the need for a three or four-stage 1000-pound pressure injection air compressor with intercoolers. A pump of single design provides the force for introducing the fuel into the combustion chamber. Two spray nozzles are employed and are so arranged that their sprays impinge. The head and combustion chamber are shaped so that their surfaces at all points are parallel to the sides of the fuel sprays. The object of this is to prevent the fuel fog from coming in contact with a metallic surface where it would collect as drops and result in imperfect combustion. Ignition is obtained by the heat of compression and all parts of the head, combustion chamber and cylinder which are exposed to the gases of combustion are watercooled.

Applies Leverage To New Lifting Pin

Applying a positive leverage in the act of lifting a cope a type of lift pin designed and manufactured by the U. S. Selling Co., 2755 North Washtenaw avenue, Chicago, separates the mold from the pattern in exact line and without jar. The accompanying illustration shows the application of the pin. The handle exerts a leverage of three to one and starts the mold steadily and in true alignment, this leverage acting until the cope is about 1¼ inches from the pattern, the long guide pin holding it in line for the remainder of the distance.

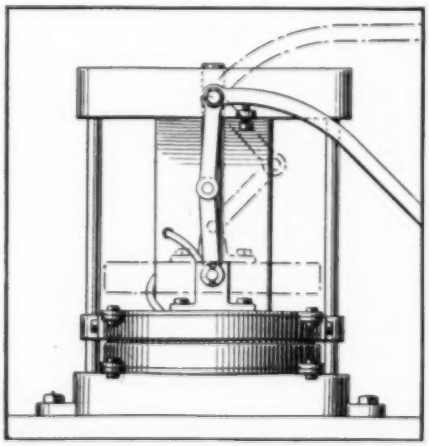
The pins can be applied to old or new flasks, of either type, common or snap. They are malleable and have long life, can be transferred from wornout to new flasks. The purpose is to reduce the patching required due to damage in lifting off the pattern.

THIS BAG HOLDER FACILITATES PLACING SMALL CASTINGS IN BAGS FOR SHIPMENT

New Press Heat Treats Saws Electrically

To simplify the heat treating of saws and flat tools, A. J. Harry, 1315 East 143rd street, Cleveland, recently has patented a new press which in addition to providing the necessary heat treatment exerts sufficient pressure on the work to prevent its warping after removal from the press. A side view of this press is shown in the accompanying illustration. The device consists of a base plate and a movable top plate which is raised and lowered by means of a handle and crank arm. Both plates are heated electrically by means of coils placed inside, the temperature being indicated by a thermocouple.

High speed steel articles such as disk saws usually are treated in a furnace to a temperature of 2250 degrees Fahr. after which they are quenched by being subjected to a lower temperature of about 1150 degrees Fahr. This second step is accomplished by quenching the tools into an oil bath at room temperature after which they are drawn again at 1150 degrees Fahr. With the new machine the saws are removed from the furnace and placed between the plates and subjected to pressure, the heating elements being operated at the same time to cool the work down from 2250 to 1150 degrees Fahr., or the red hardness point. It is claimed that the saws are maintained straight and the mechanical and structural conditions are such that no further heat treatment is required.



SKETCH OF ELECTRICAL HEAT TREATING PRESS FOR SAWS AND FLAT TOOLS

Designs Bag Holder for Packing Castings

Of special interest to producers of small castings and manufacturers shipping products in burlap bags is a convenient bag holder designed by the Malleable Iron Fittings Co., Branford, Conn. A view of the device with the bag in position is shown in the accompanying illustration. The holder is made of two semicircular steel frames at the top and bottom, which are held in place by three uprights made of steel tubing. The bag is held in position by three pointed pins turned from steel stock and threaded at one end for insertion in the steel frame.

One of the pins for the holding of bags of the larger size when the holder is inverted can be seen near the left upright in the accompanying illustration. The holder is larger at one end than at the other, and when used as shown in the illustration will accomodate bags up to 16 inches. With the holder inverted, bags up to 30 inches can be used. The holder rests on three ball shaped feet and is slid easily around the floor. It is claimed that the device will produce a saving in the cost of packing bags preparatory to shipment.

Small Cupola Set Up for Emergency Jobs

Occasional hurry-up orders for castings and the necessity of pouring a few castings on days when the amount of work on the floor did not warrant running the large cupola, prompted Sam Thompson, veteran foundry foreman at the Barbour-Stockwell Co., Cambridge, Mass., to provide the baby cupola shown in the accompanying illustration. A length of ¾-inch hose connected at one end to the compressed air line furnishes all the blast required. The other end of the hose is connected through a reducer to what corresponds to a bustle pipe and two tuyeres made up of several 2-inch bends, elbows and tees. The air is supplied at 80 pounds pressure and, due to the expansion possible in the 2-inch pipe supplying the tuyeres, it enters the cupola at greatly reduced pressure and in sufficient volume.

The shell is formed of three cylindrical sections of boiler plate 20 inches in diameter, the lower one 2 feet high and each of the others 1 foot high. The lower section is provided with two trunnions near the top by which it may be lifted by the crane and set down in any convenient location. An angle iron, attached to the inside of the shell at the bottom edge, supports the brick lining which limits the working diameter of the cupola to 14 inches. In practice the lining is daubed and then the cupola is picked up by the trunnions and set down on an iron plate supported in any convenient manner. In the illustration it is shown resting on

AN AIR HOSE SUPPLIES BLAST TO THE 2-INCH PIPE TERMINATING IN TWO TUYERES LOCATED DIAMETRICALLY OPPOSITE EACH OTHER

three wooden boxes, one at each end and one in the center to prevent the plate from springing and thus causing a leak. The coke bed is carried about 2 feet above the tuyeres and the remainder of the charge, sometimes amounting to 1000 pounds, is made up of alternate layers of coke and iron in the proportion of 1 to 5, 10 pounds of coke to 50 pounds of iron. The shell is not fastened to the plate, but maintains its position through gravity. The sand bed is rammed in the usual manner and the bottom is dropped by lifting the shell away from the bottom plate.

Builds Crane for Use in Railway Shops

A crane built particularly for railway use, but which has many applications in steel plants, industrial plants, warehouses, etc., has been introduced by the Baker R & L Co., Cleveland. The crane may also be used to supplement the traveling crane in large shops where the amount of work required exceeds that which can be accomplished by the traveling crane. The accompanying illustration shows the use of the crane in a locomotive works. In the steel plants and foundries the crane handles pig iron or scrap by means of an electromagnet which takes its power either from a second set of batteries or from an independent power line.

The crane is equipped with three motors to take care of the boom hoist, the load hoist and swiveling. The motors are controlled by push buttons on the dash directly in front of the operator who must keep his finger on the button as long as he wishes the motor to operate. As soon as he removes the finger, the power is shut off and the solenoid brake brings the motor quickly to rest. Limit switches also are provided, to prevent overrunning. The machine is built for a maximum capacity of 3000 pounds at 7-foot radius.

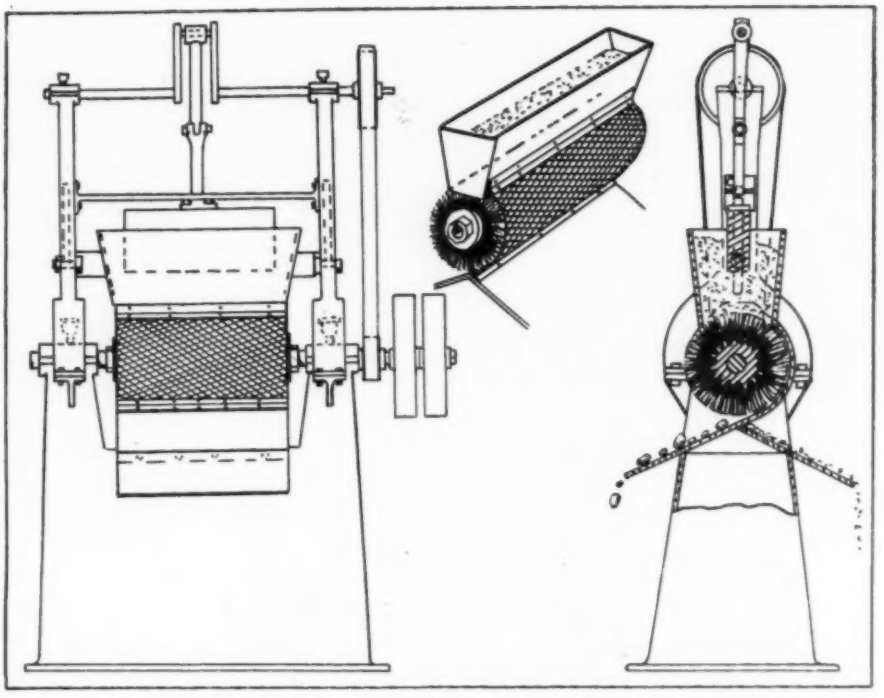


FIG. 1—FRONT ELEVATION OF ASSEMBLED MACHINE FIG. 2—PERSPECTIVE VIEW OF HOPPER, BRUSH AND SCREEN FIG. 3—SECTIONAL VIEW SHOWING DETAIL OF PLUNGER, BRUSH AND FRONT AND BACK DEFLECTING BOARDS

Design New Type Power Operated Sifter

Designed primarily for riddling wet, heavy, sticky sand, the power driven device has been patented by Henry M. Griffoul, at present connected with the John Harsch Brass and Bronze Co., Cleveland. The equipment is equally adapted to the preparation of sand while in any other condition that requires sifting. A plunger attached to a crank arm forces the sand down into the hopper where it comes into contact with a revolving brush that forces it against and through the screen. On light sand, or sand that is fairly dry, the plunger is not required. The sand will feed by gravity and the pulling action set up by the brush underneath. The screen is mounted on a steel frame attached to the hopper and brass casting. Ordinarily, a ½-inch space is provided between the brush and the screen, but the screen may be adjusted to secure varying clearances and also to take up the wear on the brush. The sand forced through the screen falls over a front deflecting board upon a heap in front of the machine. The coarse sand and other refuse gradually pass down and are discharged over the deflecting board at the back of the machine. It is not necessary to stop the machine to remove the residue. The output will vary depending on the condition of the sand and the speed with which it is shoveled into the hopper.

ELECTRIC STORAGE BATTERY CRANE BUILT FOR RAILWAY AND INDUSTRIAL PLANT WORK

Pittsburgh Foundrymen

E. J. McDonnell, sales manager of the open-hearth combustion system division of the Blaw-Knox Co., Pittsburgh, addressed the regular monthly meeting of the Pittsburgh Foundrymen's association held at the General Forbes hotel, Nov. 22.

Equipment Business Varies

Sales of Molding Machines Better in the Middle West—Foundry Equipment Less Active in the East—Automobile Foundries Remodeling During Seasonal Dullness—Some New Foundries Buying

DURING the seasonal dullness of the automobile trade a number of foundries in this class of work are making plant modifications and adding to their equipment. The Foundry Equipment Co., Cleveland, has sold a battery of four ovens to one of the branches of the General Motors Corp., located in Detroit, and the Stromberg Motor Devices Co., Chicago, has closed with the F. A. Coleman Co., Cleveland, for two rolling-drawer ovens. The Barberton Foundry Co., Barberton, O., has decided to increase its foundry capacity to make possible the production of new lines of equipment, the first of which will be machinery for rubber factories. The Wisconsin Gray Iron Foundry Co., Thirty-Ninth avenue and Burnham street, Milwaukee, is making additions and changes in both plant and equipment. New cleaning room machinery and melting and core-making facilities are being added. F. C. Haack is purchasing agent, John A. Burke, president, and E. T. Freman, superintendent.

The Lavelle Foundry Co., Anderson, Ind., which started the construction of an up-to-date plant in Indianapolis during 1921, expects soon to complete it and to start operations on light gray-iron jobbing work. Molding machines and core-oven equipment have not yet been purchased. John Lavelle Sr. is president, John Lavelle Jr., superintendent, and J. F. Stanley is plant engineer in charge of construction.

Sand-blast equipment has been sold by the Pangborn Corp., Hagerstown, Md., to a number of foundries among which are the Progressive Foundry Co., Rochester, N. Y., Buckwalter Stove Co., Royersford, Pa., Federal Malleable Co., West Allis, Wis., and Manning, Maxwell & Moore, Inc., Boston. The Standard Sand & Machine Co., Cleveland, has a number of inquiries for sand-mixing machinery and has received an order for an elevator from the Pierce, Butler & Pierce Mfg. Co. for their plant at Huntington, Pa. Molding machine companies in the Cleveland district report a fair demand for machines and parts. The Berkshire Mfg. Co. has received an order for a single machine from a new customer in New Zealand, and has a fair volume of miscellaneous business. The U. S. Cast Iron Pipe & Foundry Co., Birmingham, has placed a duplicate order for an annealing unit for centrifugal cast pipe with F. J. Ryan Co., Philadelphia. The first annealer was furnished about two months ago. This company also sold an oil-burning equipment for a 45-foot pit annealer to the American Steel Foundries, Chester, Pa.

Large Sales of Molding Machines

The Chickasaw Shipbuilding & Car Co., Birmingham, placed an order with the Herman Pneumatic Machine Co., Pittsburgh, for six jarring machines and seven large rollover machines. The American Radiator Co., Buffalo, and the American Locomotive Co., Richmond, Va., each bought two of the last named machines; the Advance Boiler Corp., Poughkeepsie, N. Y., also purchased two, together with one jar stripping plate machine. The Josiah Anstice Co., Rochester, N. Y., closed on one of the rollover type as did the Hunt-Spiller Mfg. Corp., Boston. Several more confirming orders are on the way for verbal orders already given so that altogether $150,000 to $200,000 worth of molding machines will represent November business. More activity among eastern Pennsylvania foundries is noted that at any time during the past 16 months. A core oven recently was disposed of to a Long Island, N. Y., buyer. The Union Electric Steel Co. has been adding a heat treating department as well as various kinds of equipment, including an electric furnace. The Duquesne Steel Foundry Co., Coraopolis, Pa. suffered a severe fire on November 20 and may possibly have to purchase additional equipment soon. The Guibert Steel Co., Pittsburgh, ordered a 5-ton crane from the Barber-Foster Engineering Co., Cleveland, and two 10-ton Bedford cranes were recently purchased by the Pittsburgh Foundry & Machine Co. from the L. A. Green Rail & Machinery Co., Pittsburgh. Railroad conditions have militated against prompt moving of foundry equipment.

Slowing Down in New York District

MOST of the larger foundry equipment sellers in the New York district are agreed that the past two weeks have shown a slight falling off in business. While a few sizable orders have been placed, they do not aggregate a sufficient total to offset materially, the falling off in small orders for single machines. Possibly the biggest contract placed recently involves a complete outfit for a new foundry for the Bartlett-Hayward Co., Baltimore. A substantial portion of this business is understood to have been placed with the Whiting Corp., Harvey, Ill. Another project requiring equipment is a new gray-iron foundry for the Anaconda Copper Mining Co., Anaconda, Mont. Among recent orders for this project is a 10-ton electric overhead crane, awarded the Shaw Electric Crane Works, Muskegon, Mich. Other buyers are the Brooklyn Foundry Co., Brooklyn, which has closed on a 2-ton electric crane, with 22-foot span, with the Columbia Hoist & Machine Co., Brooklyn; the American Abrasive Metals Co., Irvington, N. J. which purchased from the Shepard Electric Crane & Hoist Co., Montour Falls, a 2-ton electric crane, with 45-foot span, for its foundry; and the James Spence Iron Works, Jersey City, N. J., which has bought a 10-ton electric crane, 40-foot span, from Alfred Box & Co., Philadelphia. A company expected in the market shortly is the Connecticut Foundry Co., Rocky Hill, Conn., which is soon to start work on a foundry addition. The Burnham Boiler Co., Lancaster, Pa., previously mentioned as likely to come in the market soon, is inquiring for equipment for a new foundry, now under construction.

Of interest to the foundry equipment trade is the recent announcement by the American Brakeshoe & Foundry Co., 30 Church street, New York City, that it would dispose of its plant in Newark, N. J. This is one of the largest plants in this district and is relatively a new one, designed originally for the manufacture of automobile castings. It is generally believed in the trade that this announcement preludes the placing of considerable equipment on the market.

The Du Roch Steel Car & Truck Wheel Mfg. Co., has purchased a cupola, two geared ladles and some bowl ladles for its plant at Osgood, Pa., from the Whiting Corp., Harvey, Ill. This company also received orders for equipment as follows: U. S. Radiator Corp., Detroit, one 78-inch cupola; Neil Greibenow Co., Alexandria, Minn., one test cupola; Wm. E. Dee, Harvey, Ill., one 48-inch cupola; Aldrich Pump Co., Allentown, Pa., one 42-inch cupola; Liggett Spring & Axle Co., Monongahela, Pa., one 36 x 72-inch tumbler.

What the Foundries Are Doing

Activities of the Gray Iron, Malleable, Steel and Brass Shops

An addition will be erected by the Lycoming Motors Corp., Williamsport, Pa.

Capitalized at $100,000 the Redding Valve Co., Columbus, O., recently was incorporated by J. R. Bradford, E. K. Drumm and J. A. Drumm.

Plans are being prepared by the Connecticut Brass Co., Waterbury, Conn., for the erection of a 1-story casting shop.

The pattern shop of the Hunt-Spiller Mfg. Corp., South Boston, Mass., recently was damaged by fire.

Contract has been awarded by the Weir Stove Co., Taunton, Mass., for the erection of an addition, one story, 48 x 64 feet.

The Montreal Metal Co., 31 St. Nicholas street, Montreal, Que., plans the erection of a foundry.

Fire which started in the shipping room of the Dalton Foundry, Warsaw, Ind., did damage estimated at $10,000.

With $5000 initial capitalization the Gottlieb Iron Works, Brooklyn, N. Y., recently was incorporated by D. Gottlieb, B. Stimel and J. F. Newman, 291 Broadway, New York.

Contract has been let by the Connecticut Foundry Co., Rocky Hill, Conn., for the erection of a 2-story plant building, 30 x 70 feet, to be of brick and reinforced concrete.

Capitalized at $25,000 the Fayette Foundry & Machine Co., Scottdale, Pa., recently was incorporated by M. J. Conlon, E. J. Connare and E. D. Finnerty.

Fire which recently damaged the plant of the American Steel Foundries, Alliance, O., was of minor consequence, damaging only a brick shed. No new construction is required.

The Madison Pattern Works, 2015-2021 Winnebago street, Madison, Wis., plans the erection of an addition to its plant to be 40 x 120 feet. Chase & Sons have the contract.

The Sully Brass Foundry, Ltd., 2388 Dundas street, Toronto, Ont., is installing equipment for the production of brass, bronze and aluminum castings.

Improvements will be made to the plant of the E. N. Riddle Co., Toledo, O., manufacturer of lighting fixtures. Work on the foundry building has already been started.

An addition to cost approximately $10,000 will be built to the present plant of the Ft. Wayne Foundry & Machine Co., Ft. Wayne, Ind.

To manufacture motors, Harry A. Dahlgren, Inc., Jamestown, N. Y., has been incorporated with a capital stock of $25,000. Incorporators of the company are H. A. Dahlgren, G. L. Dahlgren and G. M. Cowan.

The building housing the stock room, pattern shop and timekeeper's office at the plant of the Fairbanks Co., Columbus, O., recently was destroyed. The building also was occupied by the Indianapolis Frog & Switch Co.

Voluntary petition in bankruptcy has been filed by the Royal Machine & Foundry Co., Oshkosh, Wis. The company manufactures bottle capping machines and other mechanical specialties. The liabilities are $26,321 and assets are $62,770, of which $32,761 is machinery, tools, etc.

The board of commerce of Parkersburg, W. Va., has announced that the Blackwood Electric Steel Foundry Co., Sandusky, O., will locate in Parkersburg. Work on the erection of a large plant building will be started soon.

The National Pump & Mfg. Co., East Chicago, Ind., has been incorporated with the following directors: Ervin S. Whitman, Thomas McKendry, Robert Banghart, Lawrence Duell and Morris Lieberman.

Damage of between $3000 and $5000 was done by fire in the melting room of the Specialty Brass Co., 805 Howland avenue, Kenosha, Wis., recently. Repairs have been made and the foundry again in operation.

Plumbing specialties will be manufactured by the Humboldt Specialties Corp., Brooklyn, N. Y., which recently was incorporated with a capital stock of $20,000. Incorporators of the company are P. M. Bloom, M. Weinstock and N. Tolk, 58 Essex street, Brooklyn.

The James A. Brady Foundry Co., Chicago, has been purchased by Ohio interests headed by L. A. Griffith of the United Machine & Mfg. Co., Canton, O. It is understood Mr. Griffith will be president of the new organization which will be formed to operate the plant.

The Alloys Foundry Co., room 750, 407 South Dearborn street, Chicago, has been incorporated with an initial capitalization of $6000. The company was incorporated by Charles B. Carter, Samuel W. Booth Jr. and Allen Erikson.

To carry on business as iron and steel makers, manufacturers of metal products, castings, etc., the Shawinigan Foundries, Ltd., Montreal, Que., recently was incorporated with a capital stock of $40,000 by Lawrence Macfarlane, Gregor Barclay, William B. Scott and others.

The plant of the Duquesne Steel Foundry Co. at Kendall Station, near Coraopolis, Pa., recently was badly damaged by fire. The fire started in the pattern shop and spread to the pattern storage building, machine shops and the two foundry structures. The damage is said to be large.

The United States Radiator Corp., Corry, Pa., has awarded a contract to the Austin Co., Cleveland, for the erection of an addition, 120 x 150 feet, according to C. E. Weir, manager. The new building will be used as a foundry. It will be of brick, steel and glass. It is to be ready Jan. 1. A new cupola will be installed and other machinery added.

Contract has been let to the Baer Construction Co. for the remodeling of the foundry building of the Great Western Stove Co., Leavenworth, Kans. The building will cover an area of 65 x 165 feet; the west end will be entirely of glass and steel frame, and will have a monitor window in one single light 142 feet long and 5 feet high. The enameling plant started last spring is nearing completion and machinery is being installed.

The Coppus Engineering & Equipment Co. and the New England Brass Foundry Co., both of Worcester, Mass., have voted to merge as the Coppus Engineering Corp., which was incorporated in July with $500,000 capital stock. The foundry will be operated as a department and will do outside work. The board of directors will be made up as follows: Frans H. C. Coppus, J. Verner Critchley, Frank A. Drury, Linwood M. Erskine, George A. Gaskill, Jerome R. George and William D. Luey.

The Premier Mfg. Co., Newton, Conn., maker of gas, electric and water instruments, has taken over the W. & B. Douglas Co., Middletown, Conn., maker of pumps, and also the Standard Metal Work Corp., Thompsonville, Conn. The Premier Mfg. Co. is to increase its capital stock to about $1,500,000 to operate the combination. Each company will continue to make its own lines but the sale and distribution will be handled by the Premier company with Middletown as the probable headquarters. Charles H. Cole is president of the latter company which has been in business 20 years. Dale D. Butler, president of the Douglas Co., will continue as such until the reorganization takes place. The Douglas Co., which is 90 years old, also operates a foundry. Mark W. Bushnell, president and treasurer of the Standard Metal Work Corp., plans to retire shortly, but his brother, Guy F. Bushnell, secretary, assistant treasurer and superintendent, will continue in an official capacity with the new owner.

New Trade Publicaitons

FLASK FILLING MACHINE—An illustrated folder has been published by the Osborn Mfg. Co., Cleveland, in which attention is called to the use of the company's flask filling machine. According to the folder it is completely idle when not elevating and discharging sand; puts the sand into the flask direct from the floor; spreads the sand evenly; is controlled and operated by one man; will increase the possible number of molds, etc. It is built as a self-contained unit, equipped with its own electric motor.

CRANE—A 6-page illustrated folder has been published by the Byers Machine Co., Ravenna, O., in which a combination crane and truck is described and illustrated. The crane is mounted on a truck of 5 tons or larger, having a minimum chassis length of 8 feet 10 inches from the rear of the driver's seat to the center of the rear axle. General specifications are given.

PUMPS—A 32-page illustrated booklet has been published by the Dayton-Dowd Co., Quincy, Ill., in which centrifugal pumps are described and illustrated. Complete data and specifications of the various types are given as well as illustrations of a number of actual installations.